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USER'S GUIDE

STRUCTURAL ANALYSIS CODE KIT

by

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DISCLAIMER

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INTRODUCTION

The Structural Analysis Code Kit (SACK) is a collective group of structural computer programs which solve typical problems encountered in analysis and design. The user is expected to be familiar with structural analyses typically found in textbooks or an engineering school curriculum. These programs are free from proprietary limitations and are smaller in scope than large commercial programs. The programs are very simple to use and understand. They will not become obsolete when new building codes are developed and updated, because of the distinct difference between analysis and design. SACK programs aid in the analysis phase of structures and give numerical answers for deflections, moments, shears, and axial loads. The results are used, in turn, to evaluate members in the design phase using current building codes to decide if acceptable member sizes are appropriate and safe.

Six individual programs comprise SACK. They are contained on separate floppy diskettes. The programs are:

1. Continuous Beam (CONTBM)

2. Plane Frame (PLFRAME)

3. Plane Truss (PLTRUSS)

4. Grid Frame (GRFRAME)

5. Space Truss (STRUSS)

6. Space Frame (SFRAME)

These programs were developed about twelve years ago in a design office where everyday structural problems were encountered. They have been tested and used extensively since that time by many engineers.

SACK programs are also helpful in checking analysis and design work performed by others, such as contractors. Instead of having to wade through the voluminous stack of calculations produced by another, these programs can provide a valuable tool in quickly evaluating their work.

SECTION 1.0

SYSTEM OPERATIONS GUIDE

1.1 System Requirements

The structural analysis programs require an IBM PC or compatible microcomputer with 512K of RAM, minimum. Five of the six programs contained in this package may be run on systems having either: (1) two 360K floppy disk drives, or (2) a hard disk drive and one 360K floppy disk drive. One of the programs, "SFRAME," stored on two 360K floppy diskettes, must be run on a hard disk drive. The disk operating system (DOS) must be version 2.0 or later. Depending on the configuration of your microcomputer and your personal preferences, the programs may be run in at least three different ways, from:

A. A hard disk.

B. A floppy disk drive using an operating system located on a hard disk or other floppy disk drive.

C. A self-booting diskette containing an operating system and one of the structural analysis programs.

OPTION A:

To prepare to run the programs from a hard disk requires two steps: (1) Prepare two system files on the hard disk, and (2) Copy the program files from the provided diskettes to the hard disk.

Preparing System files:

Two files must be located in the root directory of the hard disk: (1) "ANSI.SYS", and (2) "CONFIG.SYS". The ANSI.SYS file is found on your MS-DOS or PC-DOS diskette - copy it to the root directory. If CONFIG.SYS already exists, it is necessary to add this statement to it:

DEVICE=ANSI.SYS

This may be done using the DOS program "EDLIN" or any other word processor that will not alter the file from its ASCII standard format. If CONFIG.SYS does not exist on your hard disk, the steps listed below indicate how to create this file (the symbols ^Z mean the Control Key (CTRL) and the Z are depressed simultaneously).

```
C> COPY CON CONFIG.SYS (enter)
DEVICE=ANSI.SYS (enter)
^Z (enter)
```

Copying Programs to the Hard Disk:

Create directories on the hard disk for each of the six programs. First create a SACK directory, and then create sub-directories for each of the six structural programs.. The following list of commands is provided to illustrate this procedure (press the "enter" key after each command):

```
MD \SACK

MD \SACK\PLFRAME

MD \SACK\CONTBM

MD \SACK\GRFRAME

MD \SACK\PLTRUSS

MD \SACK\STRUSS

MD \SACK\SFRAME
```

Now copy the programs from the diskettes provided to the respective directories just created on the hard disk. For example, place the diskette labeled PLFRAME into either the 360KB or a 1.2MB disk drive and from the C\> prompt enter:

```
CD \SACK\PLFRAME (enter)
```

Then, assuming the program diskette is in the "A" drive, enter:

```
COPY A:PLFRAME.EXE (enter)
```

NOTE: All files located on both SFRAME diskettes should be copied into the \SACK\SFRAME directory.

Once these steps are accomplished, the system should be rebooted before the programs are run. The input data file and the analysis results file (described in section 1.2) will be created in the same directory that the program resides.

OPTION B:

This section describes how to run the programs from the provided diskettes. The operating system may be located on a hard disk or other floppy disk drive. It is recommended that you make backup copies of each of the provided diskettes before using them for routinely running the programs.

If your operating system is located on a hard disk, follow the steps described in Option A, "Preparing System Files," then reboot the system. Before attempting to run the programs (as described under Section 1.2) make the disk drive where the program files are located the default drive. For example, if the program diskette is in drive "A", enter A: and press enter.

If your operating system is located on a floppy, it is necessary that the files CONFIG.SYS and ANSI.SYS be included. Also, it may be necessary to copy the ANSI.SYS file from your second DOS disk to your primary one. As described above, reboot the system and make the drive where the program files are located the default drive before running the program.

The input data file and the analysis results file (described in Section 1.2) will be created on the same diskette where the program resides.

Note: OPTION B may not be used for SFRAME.

OPTION C:

If your computer is configured to boot itself from a 1.2 megabyte (MB) drive, you may create self-booting program diskettes that will contain both the operating system and one of the programs per 1.2 MB diskette.

The user must first format a new 1.2 MB diskette for each program with the following command, assuming the "A" drive is the default drive:

	FORMAT /s	(for systems with a 1.2 MB "A" drive)
or	FORMAT B:/s	(for systems with a 1.2 MB "B" drive)

Next, copy all files from each program disk onto its respective formatted diskette. Also copy the ANSI.SYS file from the MS-DOS or PC-DOS diskette onto each diskette. Finally, reboot the system with the new bootable program diskette in the boot drive.

The input data file and the analysis results file (described in Section 1.2) will be created on the same diskette that the program resides.

Note: OPTION C may not be used for SFRAME.

1.2 Running the Structural Analysis Software

To run any of the programs, the computer system must be configured according to one of the options discussed in section one. Once the computer has been properly configured, the software is run by entering the name of the program as shown:

Program Name	Function
PLFRAME	Plane Frame Analysis
CONTBM	Continuous Beam Analysis
GRFRAME	Grid Frame Analysis
PLTRUSS	Plane Truss Analysis
STRUSS	Space Truss Analysis
SFRAME	Space Frame Analysis

An introductory screen will be displayed. A screen that contains unrecognizable letters that are shifted far to the left indicates that the system has not been configured correctly. If this occurs, return to Section 1 of this guide and follow the instructions completely. If the introductory screen is centered and legible, continue the program by following the directions.

Following a brief description of the program and its limitations, the Main Menu screen is displayed. At this point, the user must select from one of the following 3 options:

1. Select a previously defined data file and run the analysis

2. Develop a new data file and run the analysis

3. Return to the operating system

Option number 1 allows the user to use previously developed data files and perform the specific analysis for this file. Option number 2 assists the user in development of a new data file. This option also runs the analysis for this newly developed file. Option number 3 exits the program and returns you to the operating system.

Note: At any time the user may interrupt the program and return to the operating system by pressing CTRL-C simultaneously.

After the user selects option number 1 or option number 2 a screen is displayed which requests the data input file name and the analysis results output file name. Any name consistent with DOS naming conventions may be selected. If the user has selected option number 1 (to run the analysis for a previously developed file), the file name of a previously developed file must be entered exactly or an error will occur.

After the file names are entered, one of two things will occur. If the user is running the analysis for a previously developed file (option number 1 of the Main Menu), the analysis will be performed at this time. See Section 1.4, Reviewing the Program Results, of this guide to view the results of the analysis. If the user has selected option number 2 (develop a new data file and perform the analysis), a series of data input screens will appear. Refer to Section 1.3, Data Input, of this guide for the details. Following successful data entry, the analysis is run and results are copied onto the output file specified in the previous step. Refer to Section 1.4, Review the Program Results, for information regarding the results.

1.3 Data Input

The data input screens for each program are self explanatory. After entering the requested value in the units specified the user must press the return key to continue to the next value. The user may not enter any non-numeric data with the exception of descriptions. The user must not enter unit names. If a data entry mistake is made, the following message will be displayed:

DATA ENTRY ERROR - PLEASE TRY AGAIN

At this point the user will be requested to re-enter all data for the screen in which a mistake occurred.

If at any time the user wishes to re-enter values for the presently displayed screen, a non-numerical or character value may be entered. This will trigger the error mode, at which point the user will be requested to re-enter all values for the present screen. If the user identifies that a mistake has been made on a previous screen, there is no way for the program to return to a screen that is no longer being displayed.

1.4 Reviewing the Program Results

After the program performs the analysis, the results are displayed in the designated output file. Any word processing program may be used to review the results. The output may be formatted using the word processor for inclusion in reports or other technical documents. The contents of the analysis results file may also be viewed using the following DOS command:

```
TYPE [drive:]filename
```

The analysis results may be printed using the word processor printing option or the DOS print command.

SECTION 2.0

COMMON PROGRAM INFORMATION

Each of the six structural programs require that data be entered interactively on a series of screens which appear on the PC monitor. The various screens are catagorized by specific information commonly found in each program. Those information screens are listed in this section with a brief description. A summary of information screens are also listed at the beginning of each program in Section 3.0.

2.1 Input

2.1.1 Structural Data Information Screen

This screen normally requires:

- Number of Members
- Modulus of Elasticity
- Modulus of Rigidity or Shear Modulus (if required)
- Number of Joints

The maximum number of members and number of joints for each program are given:

Program	Max. No. of Members	Max. No. of Joints
CONTBM	100	101
PLFRAME	50	50
PLTRUSS	50	50
GRFRAME	50	50
STRUSS	150	50
SFRAME	50	25

Each member shall have a constant cross section and be homogeneous in material. Problems using relative values of the Modulus of Elasticity may be modelled by transforming the member cross-sectional properties.

2.1.2 Joint Information Screen

Each joint is numbered and the location of each joint is required on this set of screens. The order in which the joints are numbered on the structure is immaterial, but joints must be keyed-in starting with joint 1 and following in sequential order. The coordinates are based upon the structure's global axes which are arbitrary. Associated within each joint will be degrees of freedom, normally referred to as restraints. If a joint is free to translate or rotate in a given direction or about a specific axis, use "0". If restrained from movement, use "1". In the output results of a problem, the structure's joint reactions will have numerical values only where a corresponding restraint of "1" has been defined.

2.1.3 Member Information Screen

Each member is numbered and the location of each member is required on this set of screens as well as the member's cross-sectional properties. The order in which the members are numbered on the structure is immaterial, but members must be keyed-in starting with member 1, and following in sequential order. A member is located by defining a left and right joint index. Each index is simply a joint number as previously defined. It is arbitrary as to which is the left or right index, but a set of member axes will be defined which are independent of the structure's global axes. Whichever joint number is defined as the left index, that is the "J" end, and the far joint is the "K" end. The member's axes have their origin at the "J" end. Positive "X_m" axis always proceeds from the "J" end toward the "K" end. The member's positive orientation of the "Y_m" and "Z_m" axes are established and may be seen graphically at the beginning of each program in Section 3.0. The member axes are important because the same sign convention and orientation are used when inputting the Member Loading Information, described later in Section 2.1.7. Also, in the output results of a problem; axial, shear, and moment values corresponding to the member's own axes will be generated.

Each member will require input of area and moment of inertias. The Torsion Constant may be required and must not be confused with the Polar Moment of Inertia of the cross-section, except in the special case of a round cylindrical member. Values of the Torsion Constant may be found in standard engineering textbooks when torsion is discussed. For convenience, Table 1 (at the end of this section) is given for a few cross-sectional shapes.

2.1.4 Load Case Information Screen

This screen requires information about how many joints are externally loaded; how many members have intermediate loads between each end; and how many joints have a given settlement. The user may also provide a brief description of the problem or load case. If any input information is "0", the following screens which concern that particular information will be skipped over. In the event that more load cases will be solved, the program will return to this screen for more information.

2.1.5 Settlement Information Screen

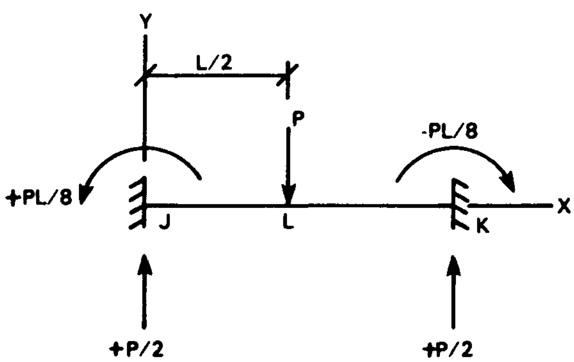
The joint number and given settlements are entered on this screen. A separate screen will be furnished for each joint where a settlement is given. The sign convention for translation and rotation of a joint are based upon the structure's global axes and the right hand rule. The right hand rule uses the fingers of the right hand to point in the direction of the rotation and the thumb direction indicates the sign convention. The settlements given here at a joint will be identical to the final structure's displacements in the output results for that joint.

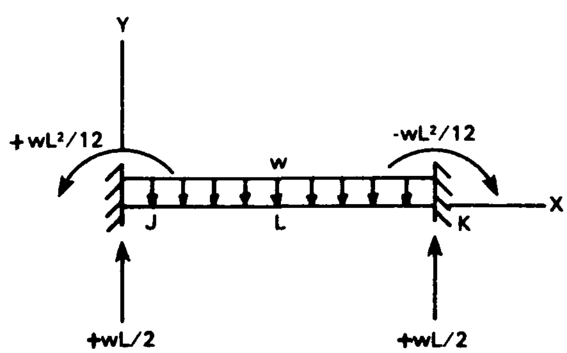
2.1.6 Joint Load Information Screen

The joint number and given loads are entered on this screen. A separate screen will be furnished for each joint where a load is given. The sign convention for the loads are based upon the structure's global axes and the right hand rule. The right hand rule uses the fingers of the right hand to point in the the direction of the moment, and the thumb direction indicates the sign convention.

2.1.7 Member Loading Information Screen

The member number and given member end-actions are entered on this screen. A separate screen will be furnished for each member where an intermediate load is given. Loads on the members are taken into account by calculating the fixed-end actions that they produce. These fixed-end actions become equivalent joint loads. The sign convention for the fixed-end actions are based upon the individual member axes and the right hand rule. Actions are required for the "J" and "K" end of the member. The right hand rule uses the fingers of the right hand to point in the direction of the moment, and the thumb direction indicates the sign convention. Typical examples are shown below:





2.1.8 More Load Case Information Screen

This screen simply asks the question of whether more load cases will be applied to the same structure. If answered "N", the solution is complete. If answered "Y", the program returns to the Load Case Information Screen, in Section 2.1.4, and continues as previously explained for a new case. The maximum number of load cases is limited only by available storage. In the Continuous Beam program, this screen is not displayed because only one load case is solved at one time.

2.2 Output

Each of the six structural programs is similar in their output of results. Each program will echo back the input values; give displacements; and list member end-actions and support reactions.

The echo back of input gives a good check of information.

The displacements are given for each joint in the structure. Orientation and sign convention are based upon structure's global axes.

Member end-actions such as axial, shear, and moment are given at each end of each member in the structure and the orientation and sign convention are based upon the member's own axes.

The support reactions are given for each support which is restrained. The orientation and sign convention are based upon the structure's global axes.

Table 1. Properties of Sections

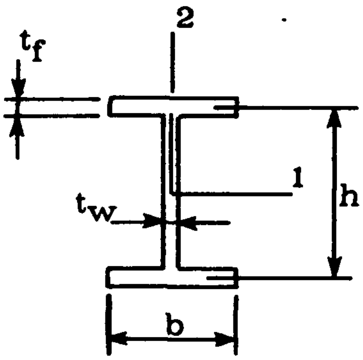
Symbols

I_1 = Moment of inertia about 1 axis

I_2 = Moment of inertia about 2 axis

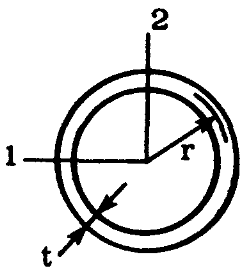
A = Area of cross section

J = Torsion constant



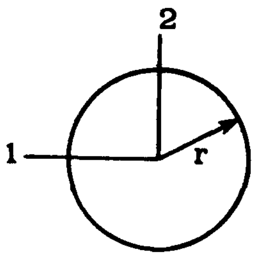
$$I_1 \approx \frac{h^2}{12}\,(ht_w + 6bt_f) \qquad I_2 \approx \frac{b^3 t_f}{6}$$

$$A \approx ht_w + 2bt_f \qquad J \approx \frac{1}{3}\,(ht_w^3 + 2bt_f^3)$$



$$I_1 = I_2 \approx \pi r^3 t$$

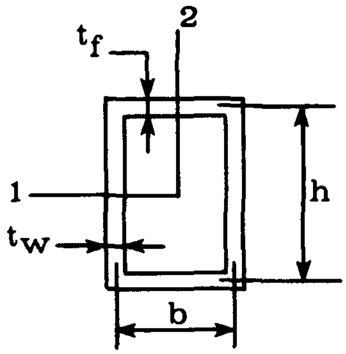
$$A \approx 2\pi rt \qquad J \approx 2\pi r^3 t$$



$$I_1 = I_2 = \frac{\pi r^4}{4}$$

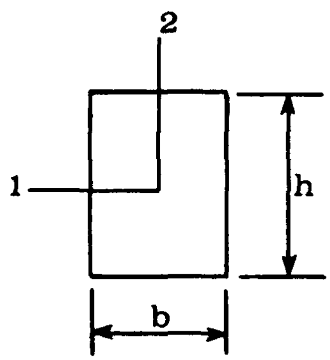
$$A = \pi r^2 \qquad J = \frac{\pi r^4}{2}$$

Table 1. Continued



$$I_1 \approx \frac{h^2}{6}(ht_w + 3bt_f) \qquad I_2 \approx \frac{b^2}{6}(bt_f + 3ht_w)$$

$$A = 2(bt_f + ht_w) \qquad J \approx 2b^2h^2 \frac{t_f\, t_w}{bt_w + ht_f}$$



$$I_1 = \frac{bh^3}{12} \qquad I_2 = \frac{hb^3}{12}$$

$$J = \beta hb^3$$

$$A = bh \qquad \beta \approx \frac{1}{3} - 0.21\,\frac{b}{h}\left(1 - \frac{b^4}{12h^4}\right)$$

Table 2. Sign Convention Summary

	Information	Axes Orientation
	Input	
2.1.1	Structural Data Screen	----
2.1.2	Joint Information Screen	global
2.1.3	Member Information Screen	member
2.1.4	Load Case Information Screen	----
2.1.5	Settlement Information Screen	global
2.1.6	Joint Load Information Screen	global
2.1.7	Member Loading Information Screen	member
2.1.8	More Load Case Information Screen	----
	Output	
	Displacements	global
	Member End-Actions	member
	Support Reactions	global

SECTION 3.0

STRUCTURAL PROGRAMS - INFORMATION AND EXAMPLES

Each of the six structural programs in this section contain the following information:

1. Program Screen Summary

2. Typical Member Axes Orientation

3. An Example Problem showing the:

   a) Structure

   b) Computer Model

   c) Input File

   d) Output File

   e) Global Reactions of Structure

   f) Internal Forces of Typical Member

3.1 Continuous Beam Analysis (CONTBM)

The Continuous Beam program analyzes continuous beams of prismatic bars that take shear forces and moments. Presently, it can handle continuous beams of up to 100 members. Any joint can be given vertical and angular displacements. This program only solves one load case at one time.

Hinges can be accounted for by placing a short, flimsy member at the desired hinge location. A·member length of 0.01 inch and a moment of inertia of 0.0001 has been used successfully.

This program may analyze beams on elastic supports if desired. These types of problems would normally be described in standard textbooks dealing with beams on elastic foundations. On the Structural Data Screen, a Spring Constant Factor is required and may either be zero or the integer "1". Use zero if there are no spring constants given in the problem. Use "1" if there are any given spring constants. Later, the user will be prompted with a Spring Information Screen only if the Spring Constant Factor is "1". At that time, it will be necessary to input values of spring constants for each joint. Some values may be zero.

CONTINUOUS BEAM PROGRAM SCREEN SUMMARY

STRUCTURAL DATA SCREEN

NUMBER OF MEMBERS:
MODULUS OF ELASTICITY (KSI):
NUMBER OF LOADED MEMBERS:
NUMBER OF LOADED JOINTS:
SPRING CONSTANT FACTOR:

MEMBER INFORMATION SCREEN

LENGTH OF MEMBER (INCHES):
MOMENT OF INERTIA (INCHES**4):

JOINT LOAD INFORMATION SCREEN

VERTICAL JOINT LOAD (KIPS):
MOMENT JOINT LOAD (KIP-IN):

MEMBER LOADING INFORMATION SCREEN

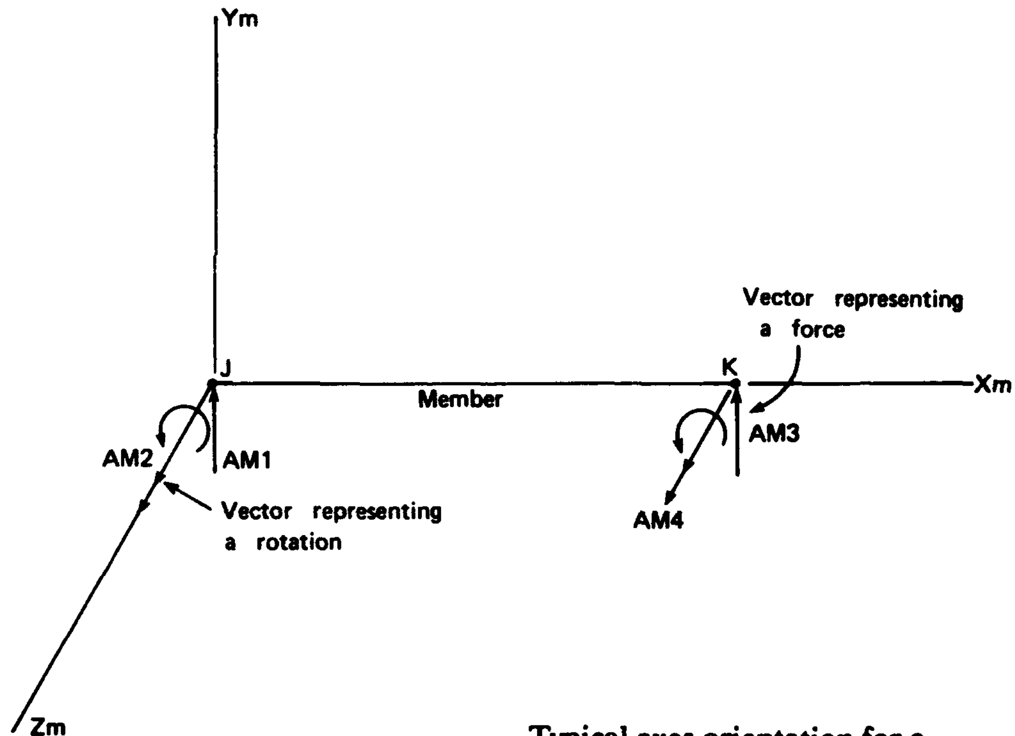
FORCE IN Y_m DIRECTION AT J END (KIPS):
MOMENT ABOUT Z_m AXIS AT J END (KIP-IN):
FORCE IN Y_m DIRECTION AT K END (KIPS):
MOMENT ABOUT Z_m AXIS AT K END (KIP-IN):

SPRING INFORMATION SCREEN

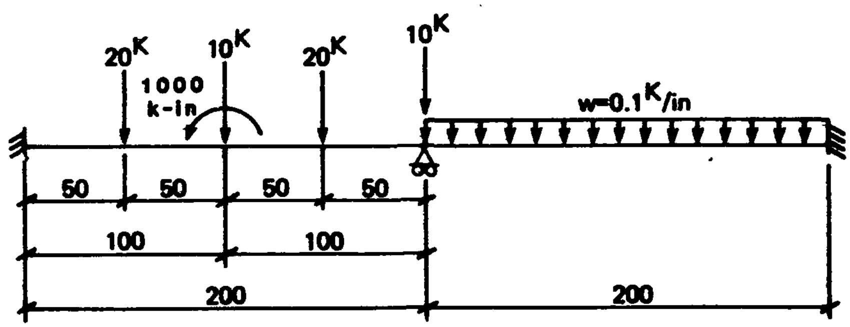
VERTICAL SPRING CONSTANT (KIP/IN):
ROTATIONAL SPRING CONSTANT (KIP/RADIAN):

JOINT RESTRAINTS AND SETTLEMENTS INFORMATION SCREEN

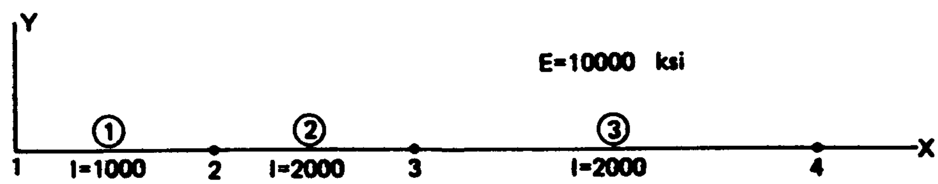
TRANSLATIONAL RESTRAINT IN Y DIRECTION:
ROTATIONAL RESTRAINT ABOUT Z AXIS:
VERTICAL SETTLEMENT (INCHES):
ROTATIONAL SETTLEMENT (RADIANS):



Typical axes orientation for a continuous beam member; positive direction shown.



Typical representation of the continuous beam structure.



Computer model of the above structure.

INPUT FILE

3	10000.00	3	2	0	
1	100.00	1000.00			
2	100.00	2000.00			
3	200.00	2000.00			
1	.00	.00			
2	-10.00	1000.00			
3	-10.00	.00			
4	.00	.00			
1	10.00	250.00	10.00	-250.00	
2	10.00	250.00	10.00	-250.00	
3	10.00	333.33	10.00	-333.33	
1	1				
0	0				
1	0				
1	1				

OUTPUT FILE

STRUCTURAL DATA

NUMBER OF MEMBERS	3
MODULUS OF ELASTICITY IN KSI	10000.00
NUMBER OF LOADED MEMBERS	3
NUMBER OF LOADED JOINTS	2
SPRING FACTOR	0

MEMBER DESIGNATION, LENGTH, AND MOMENT OF INERTIA

MEMBER	RL	RIZ
1	100.00	1000.00
2	100.00	2000.00
3	200.00	2000.00

ACTIONS APPLIED AT JOINTS

JOINT	Y ACTION	Z ACTION
1	0.0	0.0
2	-10.0	1000.0
3	-10.0	0.0
4	0.0	0.0

ACTIONS AT ENDS OF RESTRAINED MEMBERS DUE TO LOADS

MEMBER	AML1 (SHEAR)	AML2 (MOM)	AML3 (SHEAR)	AML4 (MOM)
1	10.00	250.00	10.00	-250.00
2	10.00	250.00	10.00	-250.00
3	10.00	333.33	10.00	-333.33

CONSTRAINTS AND SETTLEMENTS

JOINT	Y RSTRT	Z RSTRT	Y SETT	Z SETT
1	1	1	0.0000	0.0000
2	0	0	0.0000	0.0000
3	1	0	0.0000	0.0000
4	1	1	0.0000	0.0000

JOINT DISPLACEMENTS

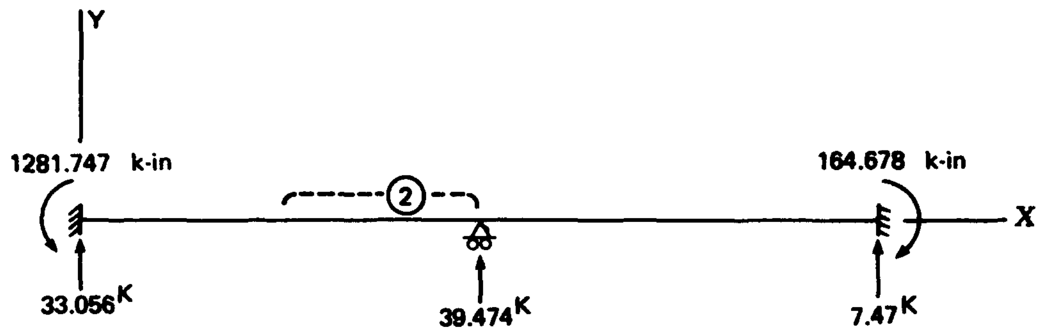
JOINT	Y DISPL.	Z DISPL.
1	0.000D+00	0.000D+00
2	-0.132D+00	0.121D-02
3	0.000D+00	0.843D-03
4	0.000D+00	0.000D+00

MEMBER END-ACTIONS

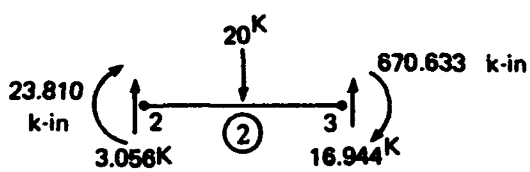
MEMBER	AM1 (SHEAR)	AM2 (MOMENT)	AM3 (SHEAR)	AM4 (MOMENT)
1	33.056	1281.747	-13.056	1023.810
2	3.056	-23.810	16.944	-670.633
3	12.530	670.633	7.470	-164.678

SUPPORT REACTIONS

JOINT	Y REACT	Z REACT
1	33.056	1281.747
2	0.000	0.000
3	39.474	0.000
4	7.470	-164.678



Representation of the global reactions of the example structure.



Representation of the internal forces of a typical member of the example problem.

3.2 Plane Frame Analysis (PLFRAME)

The Plane Frame program analyzes plane frames of prismatic bars that take axial loads, shear forces, and moments. Presently, it can handle frames having 50 members and 50 joints. Any joint can be given vertical, horizontal, and angular displacements.

The data input may be modified to consider a composite frame. If members are going to take axial loads only, such as tie rods, make the moments of inertia very small and use the actual areas. If axial deformation is to be neglected, make the member areas large and use the actual moments of inertia.

Hinges can be accounted for by placing a short, flimsy member at the desired hinge location. A member length of 0.01 inch and a moment of inertia of 0.0001 has been used successfully.

The program has the capacity to divide a straight line between two joints into any desired number of equal spaces and generate the coordinates of each joint. This part of the program is optional. The only limitation on this feature is that a support (a joint which has restraint of some kind) cannot be anywhere on the straight line. On the Structural Data Screen, the Number of Nodal Points is simply the number of joints needed to define the structure. That number may be less than the Number of Joints when the generating option is used. If joint generation is not used, the Number of Joints will be the same as the Number of Nodal points.

PLANE FRAME PROGRAM SCREEN SUMMARY

STRUCTURAL DATA SCREEN

NUMBER OF MEMBERS:
MODULUS OF ELASTICITY (KSI):
NUMBER OF JOINTS:
NUMBER OF NODAL POINTS:

JOINT INFORMATION SCREEN

JOINT NUMBER:
COORDINATE OF JOINT IN X DIRECTION (INCHES):
COORDINATE OF JOINT IN Y DIRECTION (INCHES):
TRANSLATION RESTRAINT IN X DIRECTION:
TRANSLATION RESTRAINT IN Y DIRECTION:
ROTATIONAL RESTRAINT ABOUT Z AXIS:

MEMBER INFORMATION SCREEN

LEFT JOINT INDEX FOR THE MEMBER:
RIGHT JOINT INDEX FOR THE MEMBER:
MEMBER AREA (SQ-INCHES):
MOMENT OF INERTIA ABOUT Z_m AXIS (INCHES**4):

LOAD CASE INFORMATION SCREEN

NUMBER OF LOADED JOINTS:
NUMBER OF LOADED MEMBERS:
NUMBER OF JOINTS WHERE A PRESCRIBED SETTLEMENT IS GIVEN:
BRIEF DESCRIPTION:

SETTLEMENT INFORMATION SCREEN

JOINT NUMBER WHERE A SETTLEMENT IS GIVEN:
GIVEN TRANSLATION SETTLEMENT IN X DIRECTION (INCHES):
GIVEN TRANSLATION SETTLEMENT IN Y DIRECTION (INCHES):
GIVEN ROTATIONAL SETTLEMENT ABOUT Z AXIS (RADIANS):

JOINT LOAD INFORMATION SCREEN

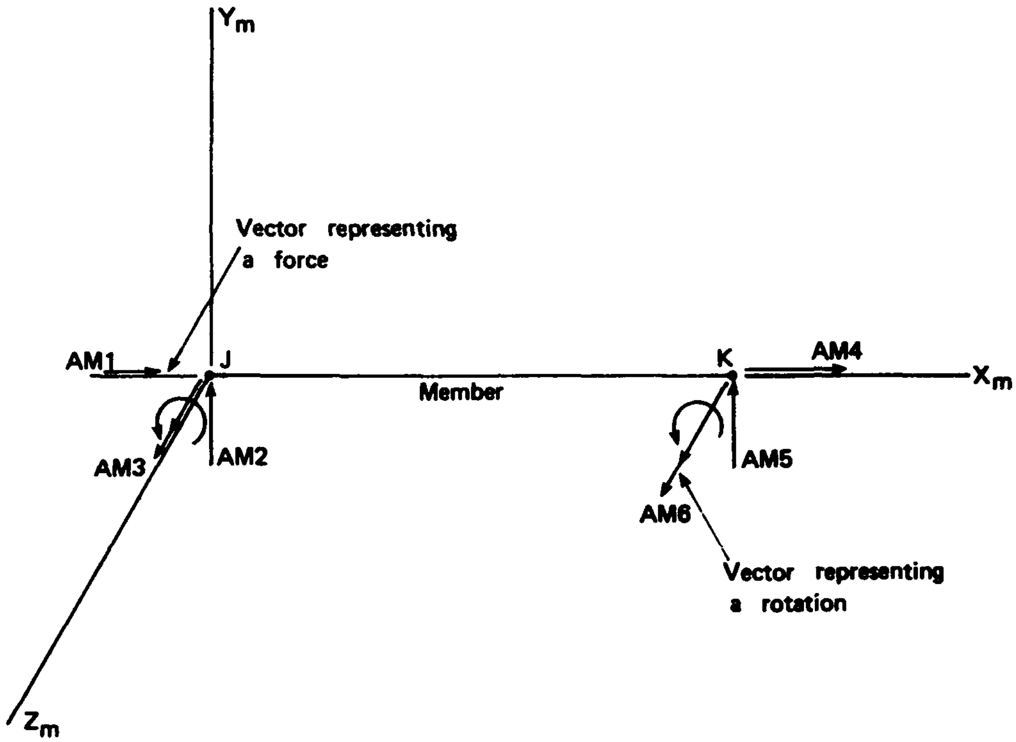
JOINT NUMBER WHERE A JOINT LOAD IS GIVEN:
FORCE IN X DIRECTION (KIPS):
FORCE IN Y DIRECTION (KIPS):
MOMENT ABOUT Z AXIS (INCH-KIPS):

MEMBER LOADING INFORMATION SCREEN

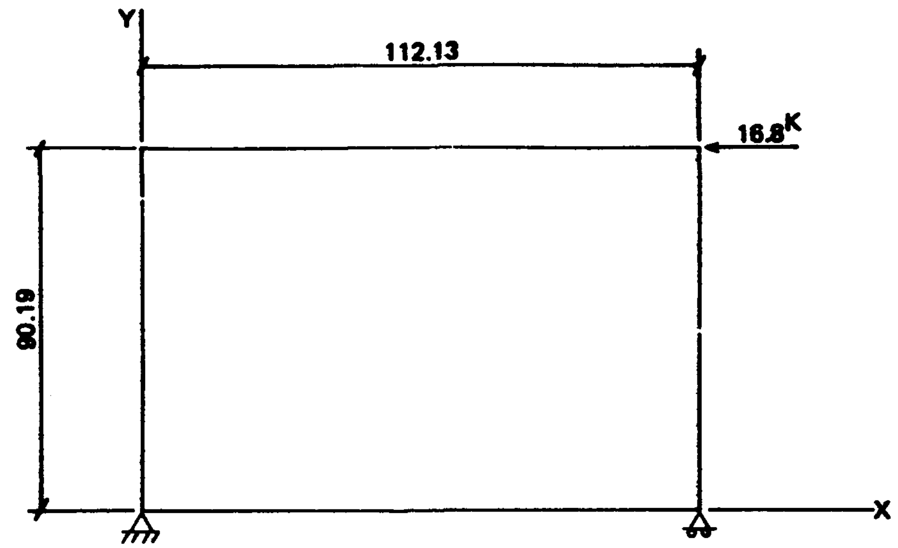
MEMBER NUMBER:
FORCE IN X_m DIRECTION AT J END (KIPS):
FORCE IN Y_m DIRECTION AT J END (KIPS):
MOMENT ABOUT Z_m AXIS AT J END (INCH-KIPS):
FORCE IN X_m DIRECTION AT K END (KIPS):
FORCE IN Y_m DIRECTION AT K END (KIPS):
MOMENT ABOUT Z_m AXIS AT K END (INCH-KIPS):

MORE LOAD CASE INFORMATION SCREEN

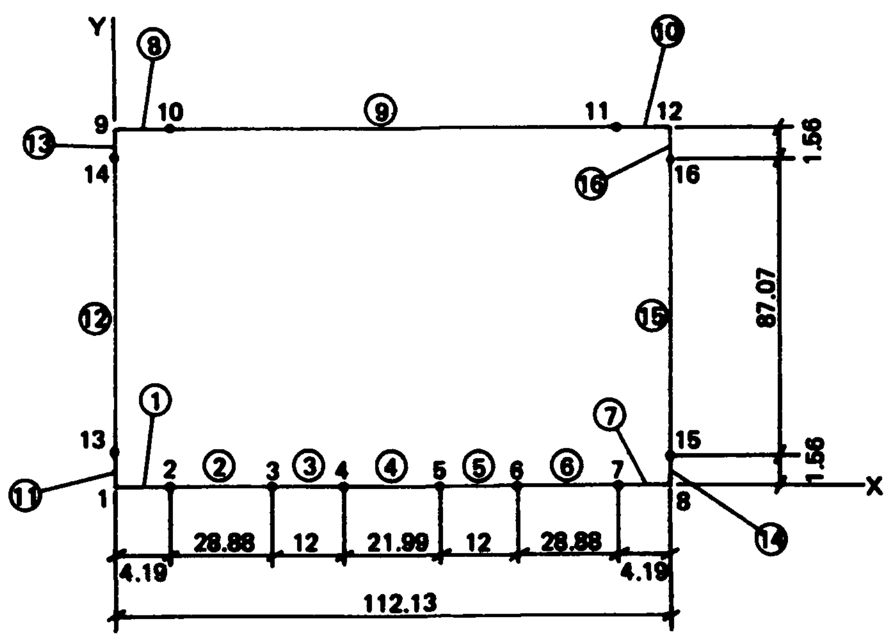
DO YOU WISH TO ANALYZE MORE LOAD CASES (Y/N)?



Typical axes orientation for a plane frame member; positive direction shown.



Typical representation of the plane frame structure.



Computer model of the above structure.

INPUT FILE

```
 16  29000.00   16    16
  1       .00        .00    1     1     0
  2      4.19        .00
  3     33.07        .00
  4     45.07        .00
  5     67.06        .00
  6     79.06        .00
  7    107.94        .00
  8    112.13        .00    0     1     0
  9       .00      90.19
 10      4.19      90.19
 11    107.94      90.19
 12    112.13      90.19
 13       .00       1.56
 14       .00      88.63
 15    112.13       1.56
 16    112.13      88.63
  1     1     2    7.390    22.140
  2     2     3    4.590    16.900
  3     3     4    4.630    22.070
  4     4     5    4.590    16.900
  5     5     6    4.630    22.070
  6     6     7    4.590    16.900
  7     7     8    7.390    22.140
  8     9    10    7.390    22.140
  9    10    11    4.590    16.900
 10    11    12    7.390    22.140
 11     1    13   10.710    74.010
 12    13    14    5.610    20.100
 13    14     9   10.710    74.010
 14     8    15   10.710    74.010
 15    15    16    5.610    20.100
 16    16    12   10.710    74.010
  1     0     0   LONG. RACKING
 12    -16.80        .00          .00
100
```

OUTPUT FILE

ANALYSIS OF PLANE FRAMES
****
STRUCTURAL DATA

NUMBER OF MEMBERS	16
MODULUS OF ELASTICITY IN KSI	29000.00
NUMBER OF JOINTS	16
NUMBER OF NODAL POINT CARDS	16

COORDINATES OF JOINTS			JOINT RESTRAINTS		
JOINT	X	Y	X RSTRT	Y RSTRT	Z RSTRT
1	0.00	0.00	1	1	0
2	4.19	0.00	0	0	0
3	33.07	0.00	0	0	0
4	45.07	0.00	0	0	0
5	67.06	0.00	0	0	0
6	79.06	0.00	0	0	0
7	107.94	0.00	0	0	0
8	112.13	0.00	0	1	0
9	0.00	90.19	0	0	0
10	4.19	90.19	0	0	0
11	107.94	90.19	0	0	0
12	112.13	90.19	0	0	0
13	0.00	1.56	0	0	0
14	0.00	88.63	0	0	0
15	112.13	1.56	0	0	0
16	112.13	88.63	0	0	0

MEMBER INFORMATION

MEMBER	JJ	JK	AX	RIZ	L	CX	CY
1	1	2	7.39	22.14	4.19	1.0000	0.0000
2	2	3	4.59	16.90	28.88	1.0000	0.0000
3	3	4	4.63	22.07	12.00	1.0000	0.0000
4	4	5	4.59	16.90	21.99	1.0000	0.0000
5	5	6	4.63	22.07	12.00	1.0000	0.0000
6	6	7	4.59	16.90	28.88	1.0000	0.0000
7	7	8	7.39	22.14	4.19	1.0000	0.0000
8	9	10	7.39	22.14	4.19	1.0000	0.0000
9	10	11	4.59	16.90	103.75	1.0000	0.0000
10	11	12	7.39	22.14	4.19	1.0000	0.0000
11	1	13	10.71	74.01	1.56	0.0000	1.0000
12	13	14	5.61	20.10	87.07	0.0000	1.0000
13	14	9	10.71	74.01	1.56	0.0000	1.0000
14	8	15	10.71	74.01	1.56	0.0000	1.0000
15	15	16	5.61	20.10	87.07	0.0000	1.0000
16	16	12	10.71	74.01	1.56	0.0000	1.0000

LOADING DATA LONG. RACKING

NUMBER OF LOADED MEMBERS	0
NUMBER OF LOADED JOINTS	1
NUMBER OF PRESCRIBED SETTLEMENTS	0

ACTION APPLIED AT JOINTS

JOINT	X ACTION	Y ACTION	Z ACTION
12	-16.80	0.00	0.00

JOINT DISPLACEMENTS

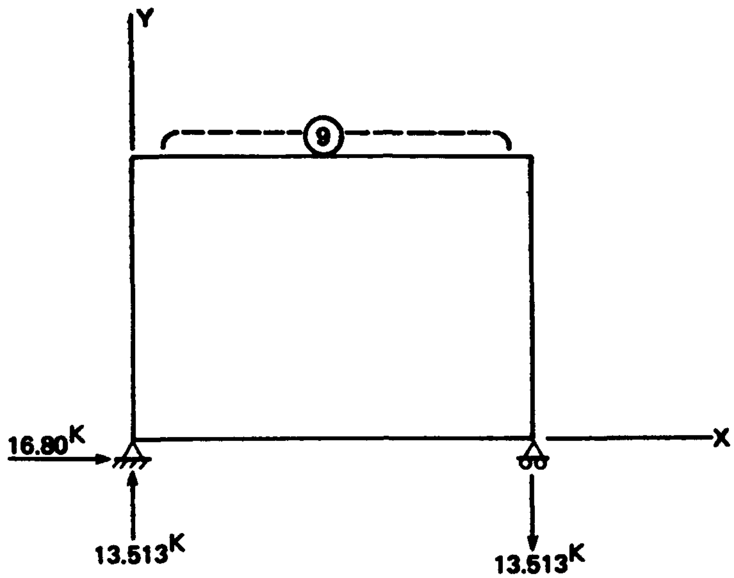
JOINT	X DISPL.	Y DISPL.	Z DISPL.
1	0.000D-01	0.000D-01	1.357D-02
2	-1.642D-04	5.179D-02	1.118D-02
3	-1.987D-03	1.311D-01	-3.770D-03
4	-2.737D-03	7.133D-02	-5.930D-03
5	-4.125D-03	-7.133D-02	-5.930D-03
6	-4.876D-03	-1.311D-01	-3.770D-03
7	-6.698D-03	-5.179D-02	1.118D-02
8	-6.863D-03	0.000D-01	1.357D-02
9	-2.049D+00	-3.672D-03	1.375D-02
10	-2.049D+00	4.893D-02	1.138D-02
11	-2.056D+00	-4.893D-02	1.138D-02
12	-2.056D+00	3.672D-03	1.375D-02
13	-2.138D-02	-3.383D-05	1.384D-02
14	-2.027D+00	-3.638D-03	1.402D-02
15	-2.824D-02	3.383D-05	1.384D-02
16	-2.034D+00	3.638D-03	1.402D-02

MEMBER END-ACTIONS

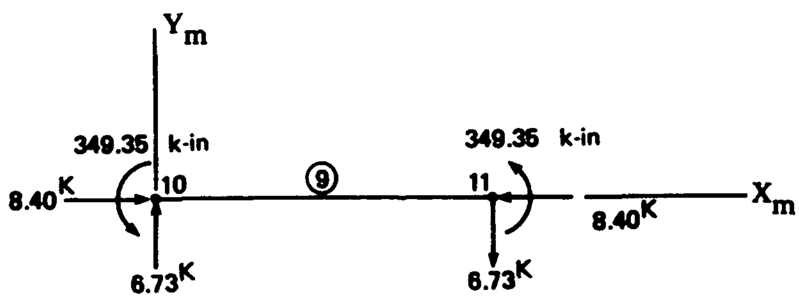
MEMBER	AM1 (AXIAL)	AM2 (SHEAR)	AM3 (MOM)	AM4 (AXIAL)	AM5 (SHEAR)	AM6 (MOM)
1	8.40	6.78	380.02	-8.40	-6.78	-351.62
2	8.40	6.78	351.62	-8.40	-6.78	-155.87
3	8.40	6.78	155.87	-8.40	-6.78	-74.53
4	8.40	6.78	74.53	-8.40	-6.78	74.53
5	8.40	6.78	-74.53	-8.40	-6.78	155.87
6	8.40	6.78	-155.87	-8.40	-6.78	351.62
7	8.40	6.78	-351.62	-8.40	-6.78	380.03
8	8.40	6.73	377.57	-8.40	-6.73	-349.35
9	8.40	6.73	349.35	-8.40	-6.73	349.35
10	8.40	6.73	-349.35	-8.40	-6.73	377.57
11	6.73	-8.40	-380.02	-6.73	8.40	366.92
12	6.73	-8.40	-366.92	-6.73	8.40	-364.47
13	6.73	-8.40	364.47	-6.73	8.40	-377.57
14	-6.73	-8.40	-380.03	6.73	8.40	366.92
15	-6.73	-8.40	-366.92	6.73	8.40	-364.47
16	-6.73	-8.40	364.47	6.73	8.40	-377.57

SUPPORT REACTIONS

JOINT	X REACT	Y REACT	Z REACT
1	16.800	13.513	0.000
8	0.000	-13.513	0.000



Representation of the global reactions of the example structure.



Representation of the internal forces of a typical member of the example problem.

3.3 Plane Truss Analysis (PLTRUSS)

The Plane Truss program analyzes plane trusses of prismatic bars that take axial loads and shear forces. Presently, it can handle trusses having 50 members and 50 joints. Any joint can be given vertical and horizontal displacements.

PLANE TRUSS PROGRAM SCREEN SUMMARY

STRUCTURAL DATA SCREEN

NUMBER OF MEMBERS:
MODULUS OF ELASTICITY (KSI):
NUMBER OF JOINTS:

JOINT INFORMATION SCREEN

COORDINATE OF JOINT IN X DIRECTION (INCHES):
COORDINATE OF JOINT IN Y DIRECTION (INCHES):
TRANSLATION RESTRAINT IN X DIRECTION:
TRANSLATION RESTRAINT IN Y DIRECTION:

MEMBER INFORMATION SCREEN

LEFT JOINT INDEX FOR THE MEMBER:
RIGHT JOINT INDEX FOR THE MEMBER:
MEMBER AREA (SQ-IN):

LOAD CASE INFORMATION SCREEN

NUMBER OF LOADED JOINTS:
NUMBER OF LOADED MEMBERS:
NUMBER OF JOINTS WHERE A PRESCRIBED SETTLEMENT IS GIVEN:
DESCRIPTION:

SETTLEMENT INFORMATION SCREEN

JOINT NUMBER WHERE A SETTLEMENT IS GIVEN:
GIVEN TRANSLATION SETTLEMENT IN X DIRECTION (INCHES):
GIVEN TRANSLATION SETTLEMENT IN Y DIRECTION (INCHES):

JOINT LOAD INFORMATION SCREEN

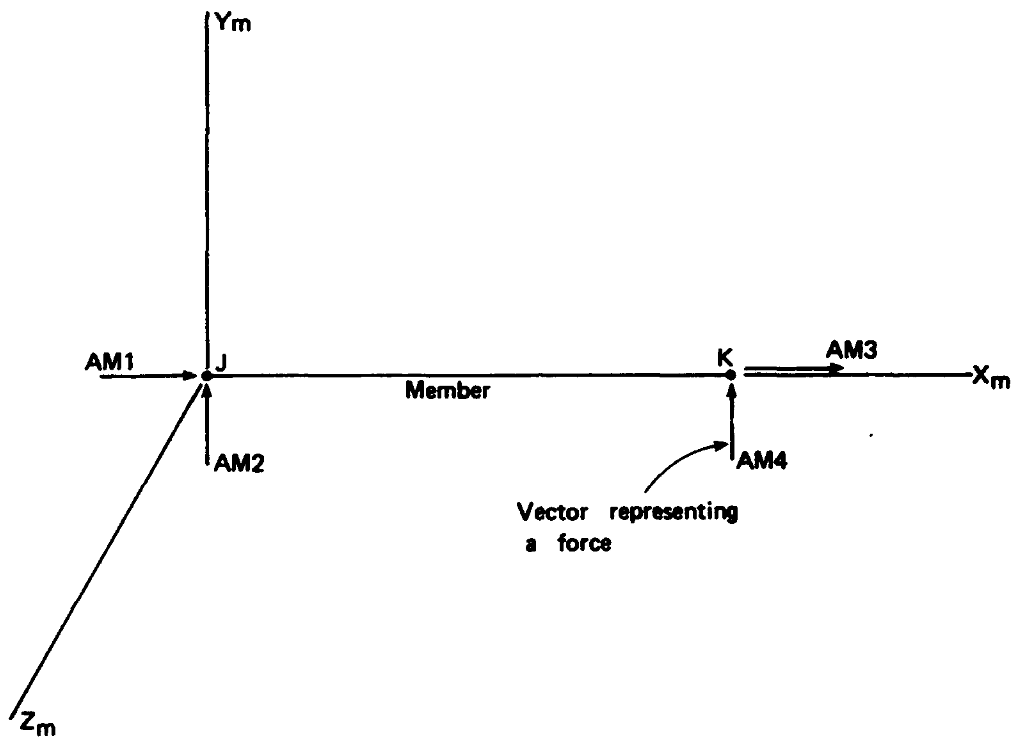
JOINT NUMBER WHERE A JOINT LOAD IS GIVEN:
FORCE IN X DIRECTION (KIPS):
FORCE IN Y DIRECTION (KIPS):

MEMBER LOADING INFORMATION SCREEN

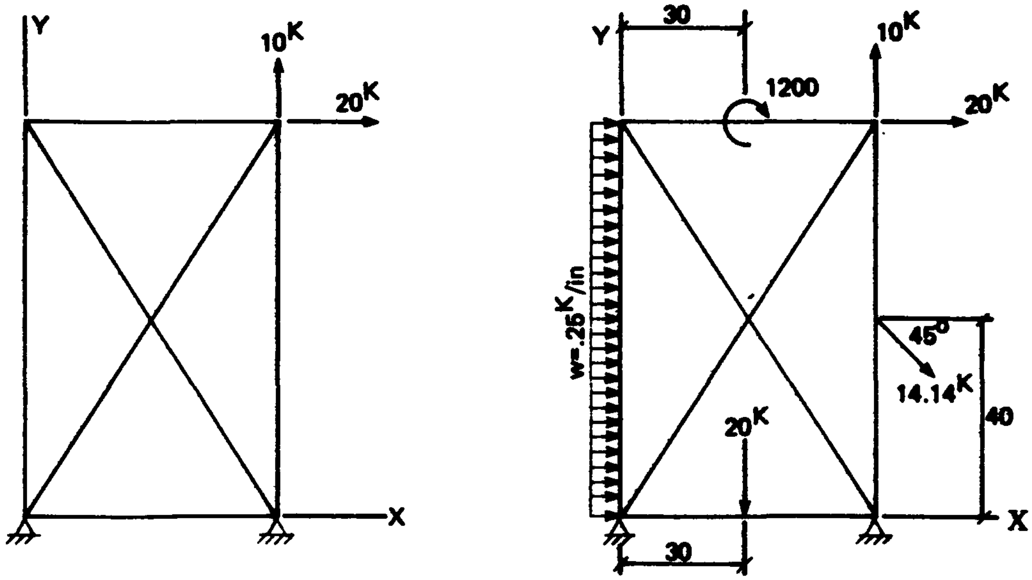
MEMBER NUMBER:
FORCE IN X_m DIRECTION AT J END (KIPS):
FORCE IN Y_m DIRECTION AT J END (KIPS):
FORCE IN X_m DIRECTION AT K END (KIPS):
FORCE IN Y_m DIRECTION AT K END (KIPS):

MORE LOAD CASE INFORMATION SCREEN

DO YOU WISH TO INPUT ADDITIONAL LOAD CASES (Y/N)?

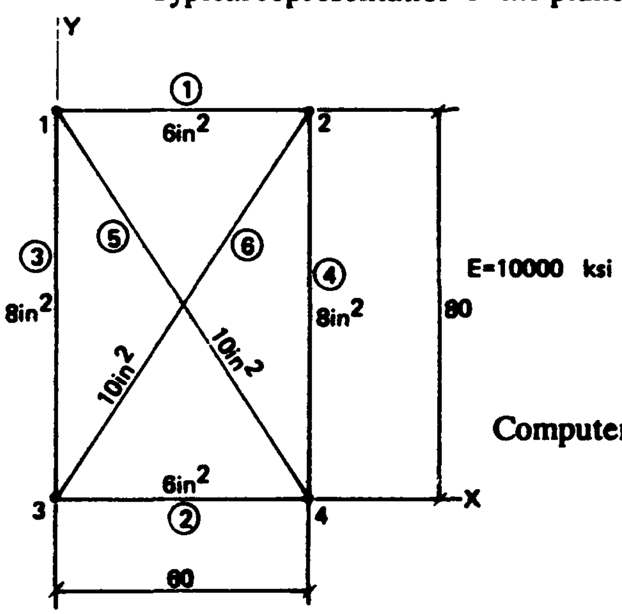


Typical axes orientation for a plane truss member; positive directions shown.



Load Case 1 Load Case 2

Typical representation of the plane truss structure.



Computer model of the above structure.

INPUT FILE

```
  6  10000.00    4
  1       .00     80.00    0    0
  2     60.00     80.00    0    0
  3       .00       .00    1    1
  4     60.00       .00    1    1
  1    1    2      6.00
  2    3    4      6.00
  3    3    1      8.00
  4    4    2      8.00
  5    1    4     10.00
  6    3    2     10.00
  1    0    0  LOAD CASE 1
  2     20.00     10.00
  0
  1    4    0  LOAD CASE 2
  2     20.00     10.00
  1       .00    -20.00               20.00
  2       .00     10.00               10.00
  3       .00     10.00               10.00
  4      5.00      5.00      5.00      5.00
100
```

OUTPUT FILE

ANALYSIS OF PLANE TRUSSES
****

STRUCTURAL DATA

NUMBER OF MEMBERS	6
MODULUS OF ELASTICITY IN KSI	10000.00
NUMBER OF JOINTS	4

COORDINATES OF JOINTS			JOINT RESTRAINTS	
JOINT	X	Y	X RSTRT	Y RSTRT
1	0.00	80.00	0	0
2	60.00	80.00	0	0
3	0.00	0.00	1	1
4	60.00	0.00	1	1

MEMBER INFORMATION

MEMBER	JJ	JK	AX	L	CX	CY
1	1	2	6.00	60.00	1.0000	0.0000
2	3	4	6.00	60.00	1.0000	0.0000
3	3	1	8.00	80.00	0.0000	1.0000
4	4	2	8.00	80.00	0.0000	1.0000
5	1	4	10.00	100.00	0.6000	-0.8000
6	3	2	10.00	100.00	0.6000	0.8000

LOADING DATA   LOAD CASE 1

NUMBER OF LOADED MEMBERS	0
NUMBER OF LOADED JOINTS	1
NUMBER OF PRESCRIBED SETTLEMENTS	0

ACTIONS APPLIED AT JOINTS

JOINT	X ACTION	Y ACTION
2	20.00	10.00

JOINT DISPLACEMENTS

JOINT	X DISPL.	Y DISPL.
1	0.350D-01	0.103D-01
2	0.427D-01	-0.641D-02
3	0.000D+00	0.000D+00
4	0.000D+00	0.000D+00

MEMBER END-ACTIONS

MEMBER	AM1 (AXIAL)	AM2 (SHEAR)	AM3 (AXIAL)	AM4 (SHEAR)
1	-7.692	0.000	7.692	0.000
2	0.000	0.000	0.000	0.000
3	-10.256	0.000	10.256	0.000
4	6.410	0.000	-6.410	0.000
5	12.821	0.000	-12.821	0.000
6	-20.513	0.000	20.513	0.000

SUPPORT REACTIONS

JOINT	X REACT	Y REACT
3	-12.308	-26.667
4	-7.692	16.667

LOADING DATA LOAD CASE 2

NUMBER OF LOADED MEMBERS 4
NUMBER OF LOADED JOINTS 1
NUMBER OF PRESCRIBED SETTLEMENTS 0

ACTIONS APPLIED AT JOINTS

JOINT	X ACTION	Y ACTION
2	20.00	10.00

ACTIONS AT ENDS OF RESTRAINED MEMBERS DUE TO LOADS

MEMBER	AML1 (AXIAL)	AML2 (SHEAR)	AML3 (AXIAL)	AML4 (SHEAR)
1	0.00	-20.00	0.00	20.00
2	0.00	10.00	0.00	10.00
3	0.00	10.00	0.00	10.00
4	5.00	5.00	5.00	5.00

JOINT DISPLACEMENTS

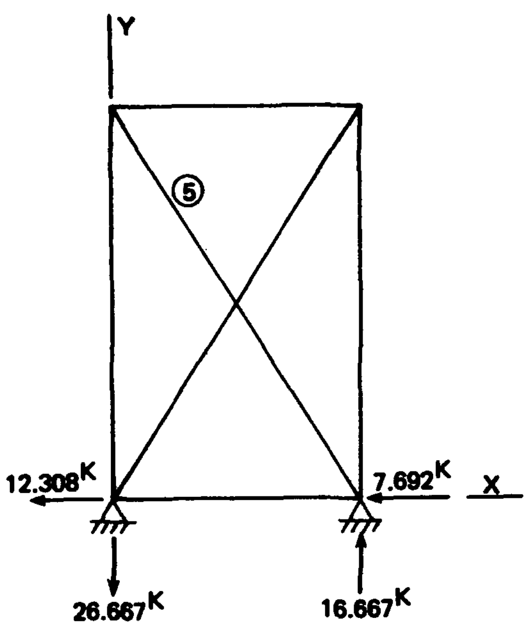
JOINT	X DISPL.	Y DISPL.
1	0.100D+00	0.415D-01
2	0.106D+00	-0.402D-01
3	0.000D+00	0.000D+00
4	0.000D+00	0.000D+00

MEMBER END-ACTIONS

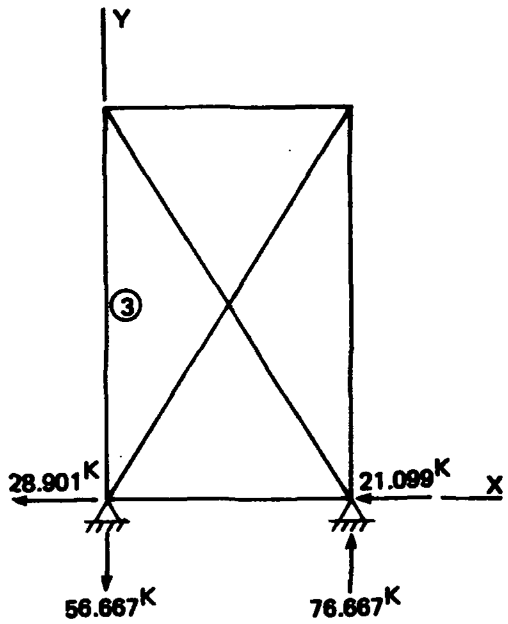
MEMBER	AM1 (AXIAL)	AM2 (SHEAR)	AM3 (AXIAL)	AM4 (SHEAR)
1	-6.099	-20.000	6.099	20.000
2	0.000	10.000	0.000	10.000
3	-41.465	10.000	41.465	10.000
4	45.201	5.000	-35.201	5.000
5	26.832	0.000	-26.832	0.000
6	-31.502	0.000	31.502	0.000

SUPPORT REACTIONS

JOINT	X REACT	Y REACT
3	-28.901	-56.667
4	-21.099	76.667

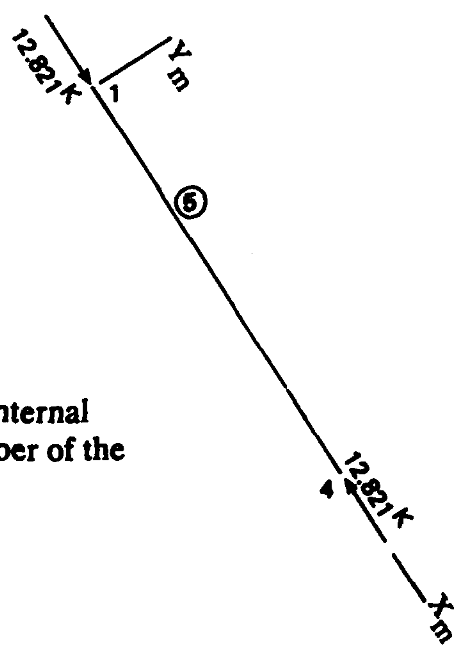


Load Case 1

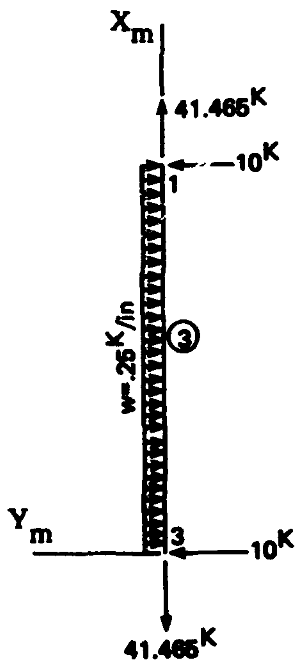


Load Case 2

Representation of the global reactions of the example structure.



Load Case 1



Load Case 2

Representation of the internal forces of a typical member of the example problem.

3.4 Grid Frame Analysis (GRFRAME)

The Grid Frame program analyzes grids of prismatic bars that take shear forces, torsion and moments. Presently, it can handle grids having 50 members and 50 joints. Any joint can be given vertical and angular displacements.

Hinges can be accounted for by placing a short, flimsy member at the desired hinge location. A member length of 0.01 inch with moment of inertia and a torsion constant of 0.0001 has been used successfully.

This program also has the option of analyzing a circular ring of a constant cross-section and loaded in a grid-like fashion. That option is available when answering "Y" to the prompt on the Ring Information Screen. A "Y" will generate a new set of screens where appropriate information is required. The program automatically generates 48 members and 48 joints under this option. The included angle between each joint is 7.5 degrees. The structure's X and Y global axes are tangent to the ring in the plan view. Therefore, the center X and Y coordinates of the ring will be the numerical equivalent of the ring radius. Joint 1 will have a X coordinate of zero and a Y coordinate equal to the ring radius. Degrees are measured from an axis between the ring center and joint 1 and going clockwise around the ring. In order to locate a joint number where either a support restraint is given or a joint load is prescribed, simply divide the number of degrees which locates a joint on the ring by 7.5 and add "1". A ring example problem has been included in this section to clarify how this option may be used.

GRID FRAME PROGRAM SCREEN SUMMARY

RING INFORMATION SCREEN

IS THE RING CIRCULAR (Y/N):

STRUCTURAL DATA SCREEN (NO RING)

NUMBER OF MEMBERS:
MODULUS OF ELASTICITY (KSI):
MODULUS OF RIGIDITY (KSI):
NUMBER OF JOINTS:

JOINT INFORMATION SCREEN (NO RING)

COORDINATE OF JOINT IN X DIRECTION (INCHES):
COORDINATE OF JOINT IN Y DIRECTION (INCHES):
ROTATION RESTRAINT ABOUT X AXIS:
ROTATION RESTRAINT ABOUT Y AXIS:
TRANSLATION RESTRAINT ABOUT Z AXIS:

MEMBER INFORMATION SCREEN (NO RING)

LEFT JOINT INDEX FOR THE MEMBER:
RIGHT JOINT INDEX FOR THE MEMBER:
TORSION CONSTANT FOR MEMBER (INCHES**4):
MOMENT OF INERTIA ABOUT Y_m AXIS (INCHES**4):

STRUCTURAL DATA SCREEN (RING)

MODULUS OF ELASTICITY (KSI):
MODULUS OF RIGIDITY (KSI):
RADIUS OF THE RING (INCHES):
TORSION CONSTANT FOR THE RING CROSS SECTION (INCHES**4):
MOMENT OF INERTIA FOR THE RING CROSS SECTION(INCHES**4):
NUMBER OF SUPPORTED JOINTS:

JOINT INFORMATION SCREEN (RING)

JOINT NUMBER:
ROTATION RESTRAINT ABOUT X AXIS:
ROTATION RESTRAINT ABOUT Y AXIS:
TRANSLATION RESTRAINT IN Z DIRECTION:

LOAD CASE INFORMATION SCREEN

NUMBER OF LOADED JOINTS:
NUMBER OF LOADED MEMBERS:
NUMBER OF JOINTS WHERE A PRESCRIBED SETTLEMENT IS GIVEN:
DESCRIPTION:

SETTLEMENT INFORMATION SCREEN

JOINT NUMBER WHERE A SETTLEMENT IS GIVEN:
GIVEN ROTATIONAL SETTLEMENT ABOUT X AXIS (RADIANS):
GIVEN ROTATIONAL SETTLEMENT ABOUT Y AXIS (RADIANS):
GIVEN TRANSLATION SETTLEMENT IN Z DIRECTION (INCHES):

JOINT LOAD INFORMATION SCREEN

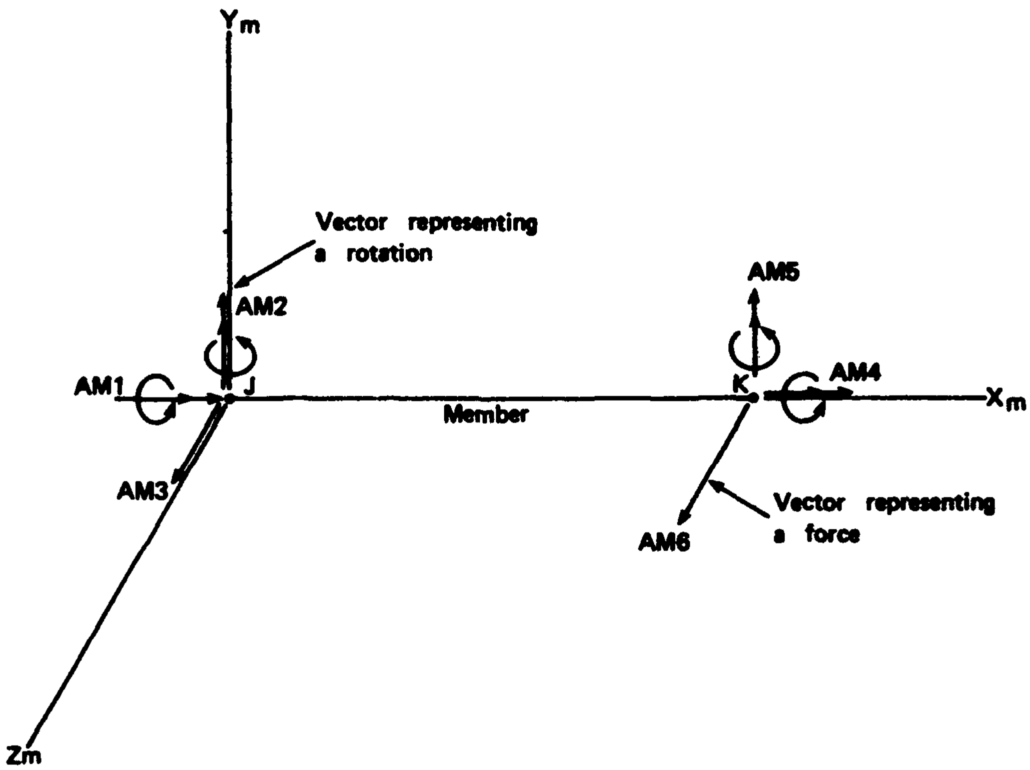
JOINT NUMBER WHERE A JOINT LOAD IS GIVEN:
MOMENT ABOUT X AXIS (INCH-KIPS):
MOMENT ABOUT Y AXIS (INCH-KIPS):
FORCE IN Z DIRECTION (KIPS):

MEMBER LOADING INFORMATION SCREEN

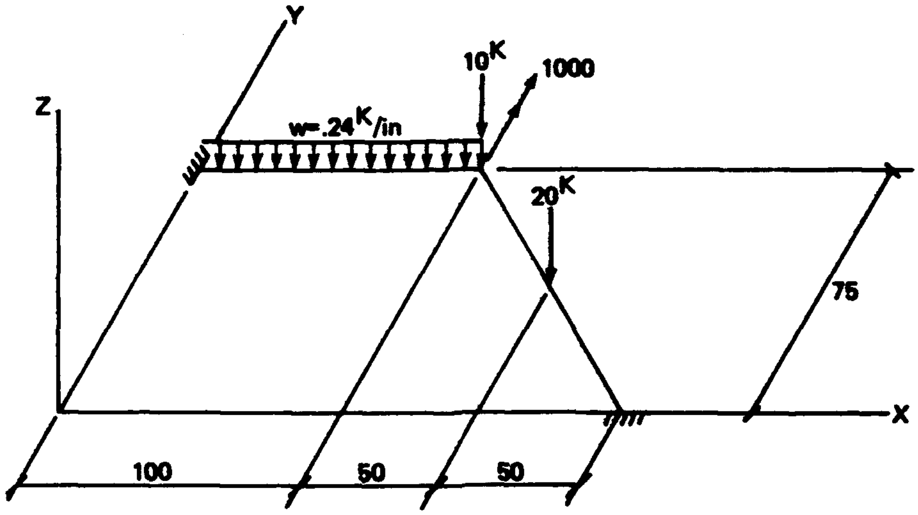
MEMBER NUMBER:
MOMENT ABOUT X_m AXIS AT J END (INCH-KIPS):
MOMENT ABOUT Y_m AXIS AT J END (INCH-KIPS):
FORCE IN Z_m DIRECTION AT J END (KIPS):
MOMENT ABOUT X_m AXIS AT K END (INCH-KIPS):
MOMENT ABOUT Y_m AXIS AT K END (INCH-KIPS):
FORCE IN Z_m DIRECTION AT K END (KIPS):

MORE LOAD CASE INFORMATION SCREEN

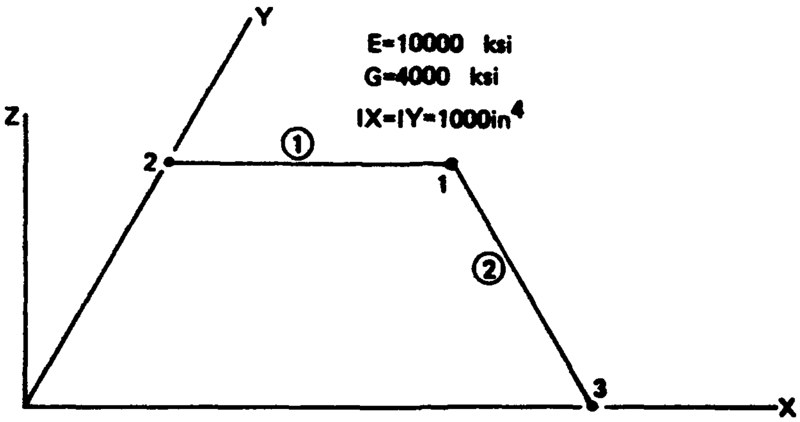
DO YOU WISH TO INPUT ADDITIONAL LOAD CASES (Y/N)?



Typical axes orientation for a grid frame member; positive directions shown.



Typical representation of the grid frame structure.



Computer model of the above structure.

INPUT FILE

```
  0
  2  10000.00   4000.00    3
  1    100.00     75.00    0     0     0
  2       .00     75.00    1     1     1
  3    200.00       .00    1     1     1
  1     2     1   1000.00  1000.00
  2     1     3   1000.00  1000.00
  1     2     0   EXAMPLE
  1       .00   1000.00    -10.00
  1       .00   -200.00     12.00         .00     200.00       12.00
  2       .00   -312.50     10.00         .00     312.50       10.00
100
```

OUTPUT FILE

ANALYSIS OF GRID FRAMES
****

STRUCTURAL DATA

NUMBER OF MEMBERS	2
MODULUS OF ELASTICITY IN KSI	10000.00
MODULUS OF RIGIDITY IN KSI	4000.00
NUMBER OF JOINTS	3

JOINT	X	Y	X RSTRT	Y RSTRT	Z RSTRT
1	100.00	75.00	0	0	0
2	0.00	75.00	1	1	1
3	200.00	0.00	1	1	1

MEMBER INFORMATION

MEMBER	JJ	JK	RIX	RIY	L	CX	CY
1	2	1	1000.00	1000.00	100.00	1.0000	0.0000
2	1	3	1000.00	1000.00	125.00	0.8000	-0.6000

LOADING DATA EXAMPLE

NUMBER OF LOADED MEMBERS	2
NUMBER OF LOADED JOINTS	1
NUMBER OF PRESCRIBED SETTLEMENTS	0

ACTION APPLIED AT JOINTS

JOINT	X ACTION	Y ACTION	Z ACTION
1	0.00	1000.00	-10.00

ACTIONS AT ENDS OF RESTRAINED MEMBERS DUE TO LOADS

MEMBER	AML1 (TOR)	AML2 (MOM)	AML3 (SHEAR)	AML4 (TOR)	AML5 (MOM)	AML6 (SHEAR)
1	0.00	-200.00	12.00	0.00	200.00	12.00
2	0.00	-312.50	10.00	0.00	312.50	10.00

JOINT DISPLACEMENTS

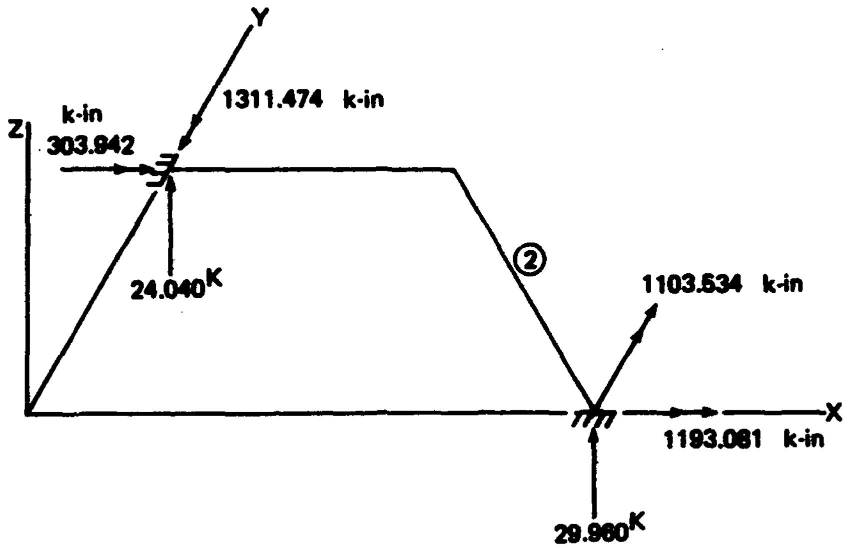
JOINT	X DISPL.	Y DISPL.	Z DISPL.
1	-7.599D-03	5.095D-03	-3.551D-01
2	0.000D-01	0.000D-01	0.000D-01
3	0.000D-01	0.000D-01	0.000D-01

MEMBER END-ACTIONS

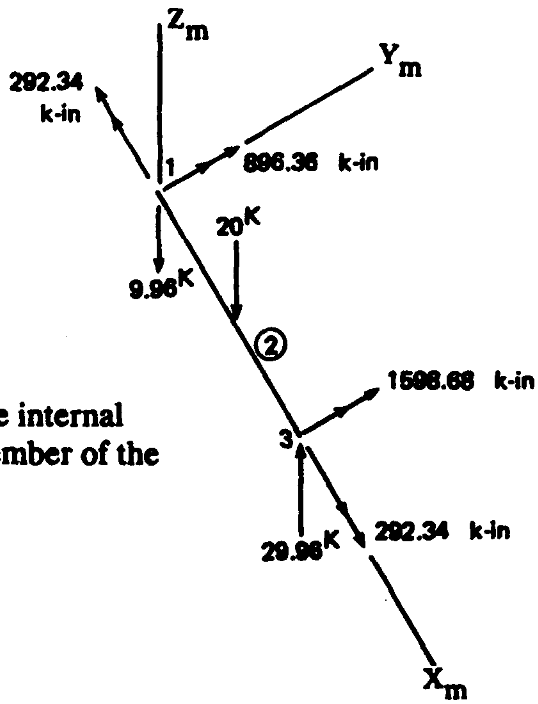
MEMBER	AM1 (TOR)	AM2 (MOM)	AM3 (SHEAR)	AM4 (TOR)	AM5 (MOM)	AM6 (SHEAR)
1	303.94	-1311.47	24.04	-303.94	107.50	-0.04
2	-292.34	896.36	-9.96	292.34	1598.68	29.96

SUPPORT REACTIONS

JOINT	X REACT	Y REACT	Z REACT
2	303.942	-1311.474	24.040
3	1193.081	1103.534	29.960

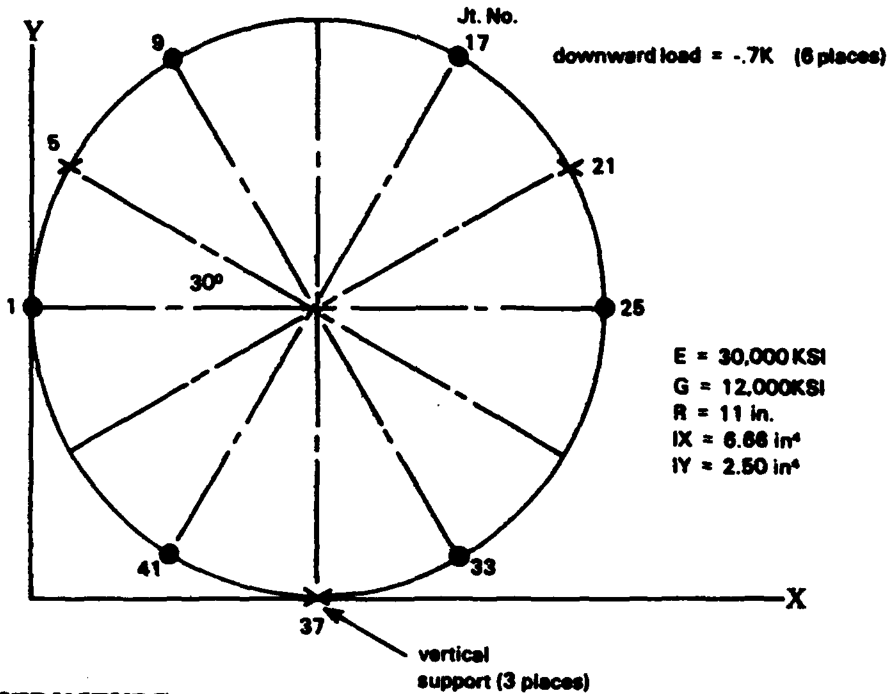


Representation of the global reactions of the example structure.

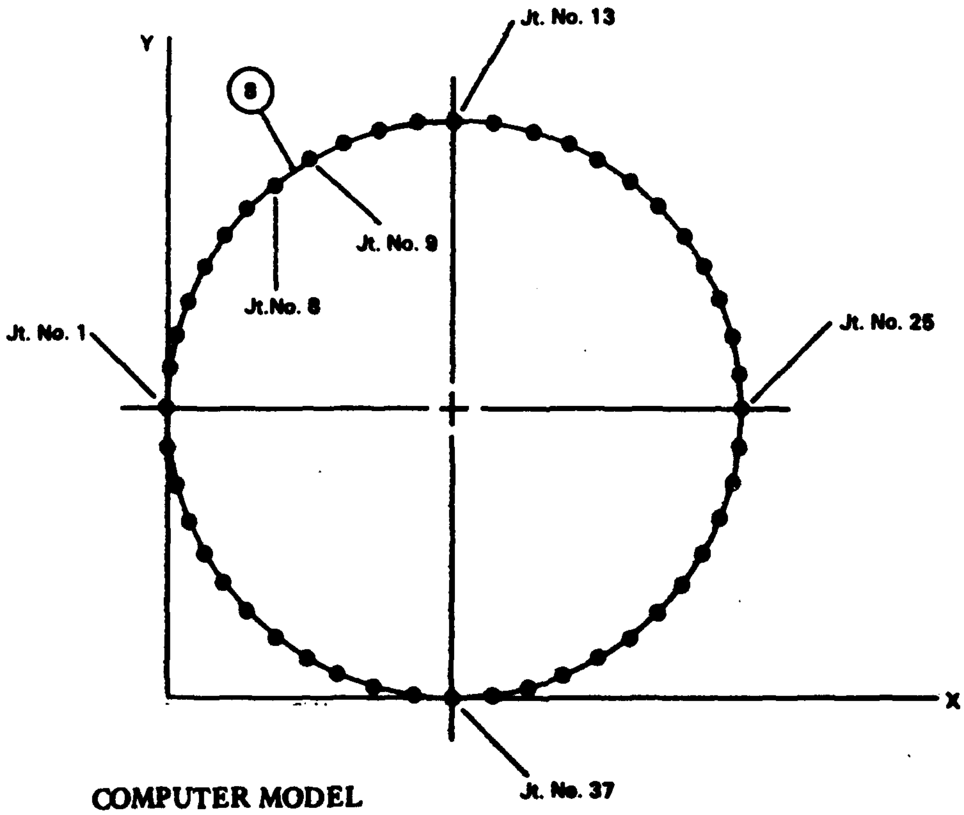


Representation of the internal forces of a typical member of the example problem.

GRID FRAME-RING



STRUCTURE



COMPUTER MODEL

Plan View

INPUT FILE

```
   1
30000.00  12000.00    11.000      6.660      2.500     3
   5    0    0    1
  21    0    0    1
  37    0    0    1
   6    0    0  RING PROBLEM
   1       .00        .00      -.70
   9       .00        .00      -.70
  17       .00        .00      -.70
  25       .00        .00      -.70
  33       .00        .00      -.70
  41       .00        .00      -.70
 100
```

OUTPUT FILE

ANALYSIS OF GRID FRAMES
****

STRUCTURAL DATA

NUMBER OF MEMBERS	48
MODULUS OF ELASTICITY IN KSI	30000.00
MODULUS OF RIGIDITY IN KSI	12000.00
NUMBER OF JOINTS	48
RADIUS OF RING IN INCHES	11.00
TORSION CONSTANT	6.66
MOMENT OF INERTIA	2.50
NUMBER OF SUPPORTED JOINTS	3

COORDINATES OF JOINTS			JOINT RESTRAINTS		
JOINT	X	Y	X RSTRT	Y RSTRT	Z RSTRT
1	.00	11.00	0	0	0
2	.09	12.44	0	0	0
3	.37	13.85	0	0	0
4	.84	15.21	0	0	0
5	1.47	16.50	0	0	1
6	2.27	17.70	0	0	0
7	3.22	18.78	0	0	0
8	4.30	19.73	0	0	0
9	5.50	20.53	0	0	0
10	6.79	21.16	0	0	0
11	8.15	21.63	0	0	0
12	9.56	21.91	0	0	0
13	11.00	22.00	0	0	0
14	12.44	21.91	0	0	0
15	13.85	21.63	0	0	0
16	15.21	21.16	0	0	0

17	16.50	20.53	0	0	0
18	17.70	19.73	0	0	0
19	18.78	18.78	0	0	0
20	19.73	17.70	0	0	0
21	20.53	16.50	0	0	1
22	21.16	15.21	0	0	0
23	21.63	13.85	0	0	0
24	21.91	12.44	0	0	0
25	22.00	11.00	0	0	0
26	21.91	9.56	0	0	0
27	21.63	8.15	0	0	0
28	21.16	6.79	0	0	0
29	20.53	5.50	0	0	0
30	19.73	4.30	0	0	0
31	18.78	3.22	0	0	0
32	17.70	2.27	0	0	0
33	16.50	1.47	0	0	0
34	15.21	.84	0	0	0
35	13.85	.37	0	0	0
36	12.44	.09	0	0	0
37	11.00	.00	0	0	1
38	9.56	.09	0	0	0
39	8.15	.37	0	0	0
40	6.79	.84	0	0	0
41	5.50	1.47	0	0	0
42	4.30	2.27	0	0	0
43	3.22	3.22	0	0	0
44	2.27	4.30	0	0	0
45	1.47	5.50	0	0	0
46	.84	6.79	0	0	0
47	.37	8.15	0	0	0
48	.09	9.56	0	0	0

MEMBER INFORMATION

MEMBER	JJ	JK	L	CX	CY
1	1	2	1.44	.0654	.9979
2	2	3	1.44	.1951	.9808
3	3	4	1.44	.3214	.9469
4	4	5	1.44	.4423	.8969
5	5	6	1.44	.5556	.8315
6	6	7	1.44	.6593	.7518
7	7	8	1.44	.7518	.6593
8	8	9	1.44	.8315	.5556
9	9	10	1.44	.8969	.4423
10	10	11	1.44	.9469	.3214
11	11	12	1.44	.9808	.1951
12	12	13	1.44	.9979	.0654
13	13	14	1.44	.9979	-.0654
14	14	15	1.44	.9808	-.1951
15	15	16	1.44	.9469	-.3214
16	16	17	1.44	.8969	-.4423
17	17	18	1.44	.8315	-.5556
18	18	19	1.44	.7518	-.6593
19	19	20	1.44	.6593	-.7518

20	20	21	1.44	.5556	-.8315
21	21	22	1.44	.4423	-.8969
22	22	23	1.44	.3214	-.9469
23	23	24	1.44	.1951	-.9808
24	24	25	1.44	.0654	-.9979
25	25	26	1.44	-.0654	-.9979
26	26	27	1.44	-.1951	-.9808
27	27	28	1.44	-.3214	-.9469
28	28	29	1.44	-.4423	-.8969
29	29	30	1.44	-.5556	-.8315
30	30	31	1.44	-.6593	-.7518
31	31	32	1.44	-.7518	-.6593
32	32	33	1.44	-.8315	-.5556
33	33	34	1.44	-.8969	-.4423
34	34	35	1.44	-.9469	-.3214
35	35	36	1.44	-.9808	-.1951
36	36	37	1.44	-.9979	-.0654
37	37	38	1.44	-.9979	.0654
38	38	39	1.44	-.9808	.1951
39	39	40	1.44	-.9469	.3214
40	40	41	1.44	-.8969	.4423
41	41	42	1.44	-.8315	.5556
42	42	43	1.44	-.7518	.6593
43	43	44	1.44	-.6593	.7518
44	44	45	1.44	-.5556	.8315
45	45	46	1.44	-.4423	.8969
46	46	47	1.44	-.3214	.9469
47	47	48	1.44	-.1951	.9808
48	48	1	1.44	-.0654	.9979

LOADING DATA   RING PROBLEM

NUMBER OF LOADED MEMBERS	0
NUMBER OF LOADED JOINTS	6
NUMBER OF PRESCRIBED SETTLEMENTS	0

ACTION APPLIED AT JOINTS

JOINT	X ACTION	Y ACTION	Z ACTION
1	.00	.00	-.70
9	.00	.00	-.70
17	.00	.00	-.70
25	.00	.00	-.70
33	.00	.00	-.70
41	.00	.00	-.70

JOINT DISPLACEMENTS

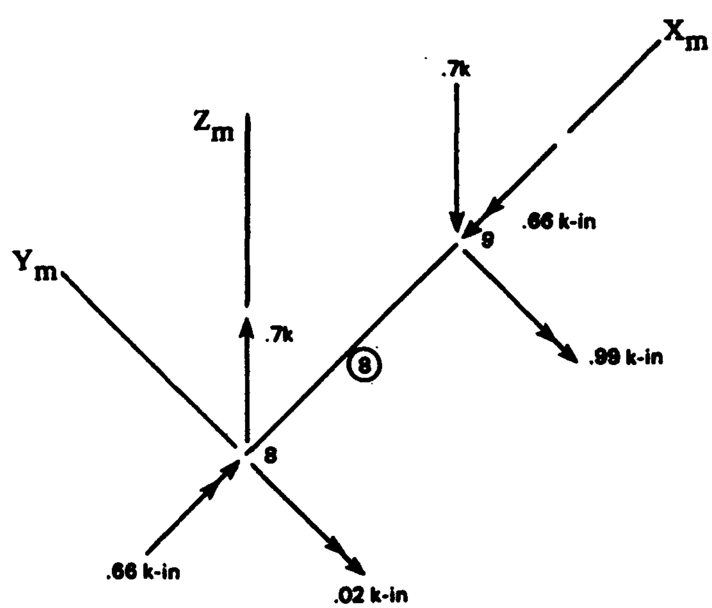
JOINT	X DISPL.	Y DISPL.	Z DISPL.
1	1.091D-04	-7.106D-06	-4.951D-04
2	1.192D-04	4.173D-06	-3.288D-04
3	1.101D-04	1.799D-05	-1.678D-04
4	8.230D-05	3.699D-05	-4.711D-05
5	3.678D-05	6.371D-05	.000D+00
6	-9.114D-06	8.977D-05	-4.711D-05
7	-3.946D-05	1.043D-04	-1.678D-04
8	-5.599D-05	1.053D-04	-3.288D-04
9	-6.070D-05	9.093D-05	-4.951D-04
10	-6.015D-05	6.835D-05	-6.364D-04
11	-5.972D-05	4.565D-05	-7.417D-04
12	-5.945D-05	2.285D-05	-8.068D-04
13	-5.936D-05	-2.113D-12	-8.288D-04
14	-5.945D-05	-2.285D-05	-8.068D-04
15	-5.972D-05	-4.565D-05	-7.417D-04
16	-6.015D-05	-6.835D-05	-6.364D-04
17	-6.070D-05	-9.093D-05	-4.951D-04
18	-5.599D-05	-1.053D-04	-3.288D-04
19	-3.946D-05	-1.043D-04	-1.678D-04
20	-9.113D-06	-8.977D-05	-4.711D-05
21	3.678D-05	-6.371D-05	.000D+00
22	8.230D-05	-3.699D-05	-4.711D-05
23	1.101D-04	-1.799D-05	-1.678D-04
24	1.192D-04	-4.173D-06	-3.288D-04
25	1.091D-04	7.106D-06	-4.951D-04
26	8.927D-05	1.791D-05	-6.364D-04
27	6.939D-05	2.889D-05	-7.417D-04
28	4.951D-05	4.006D-05	-8.068D-04
29	2.968D-05	5.140D-05	-8.288D-04
30	9.938D-06	6.291D-05	-8.068D-04
31	-9.672D-06	7.454D-05	-7.417D-04
32	-2.912D-05	8.627D-05	-6.364D-04
33	-4.840D-05	9.804D-05	-4.951D-04
34	-6.321D-05	1.011D-04	-3.288D-04
35	-7.062D-05	8.634D-05	-1.678D-04
36	-7.319D-05	5.278D-05	-4.711D-05
37	-7.357D-05	2.620D-11	.000D+00
38	-7.319D-05	-5.278D-05	-4.711D-05
39	-7.062D-05	-8.634D-05	-1.678D-04
40	-6.321D-05	-1.011D-04	-3.288D-04
41	-4.840D-05	-9.804D-05	-4.951D-04
42	-2.912D-05	-8.627D-05	-6.364D-04
43	-9.672D-06	-7.454D-05	-7.417D-04
44	9.938D-06	-6.291D-05	-8.068D-04
45	2.968D-05	-5.140D-05	-8.288D-04
46	4.951D-05	-4.006D-05	-8.068D-04
47	6.939D-05	-2.889D-05	-7.417D-04
48	8.927D-05	-1.791D-05	-6.364D-04

MEMBER END-ACTIONS

MEMBER	AM1 (TOR)	AM2 (MOM)	AM3 (SHEAR)	AM4 (TOR)	AM5 (MOM)	AM6 (SHEAR)
1	-.66	.99	-.70	.66	.02	.70
2	-.65	-.10	-.70	.65	1.11	.70
3	-.50	-1.19	-.70	.50	2.19	.70
4	-.21	-2.24	-.70	.21	3.25	.70
5	.21	-3.25	.70	-.21	2.24	-.70
6	.50	-2.19	.70	-.50	1.19	-.70
7	.65	-1.11	.70	-.65	.10	-.70
8	.66	-.02	.70	-.66	-.99	-.70
9	.53	1.07	.00	-.53	-1.07	.00
10	.38	1.13	.00	-.38	-1.13	.00
11	.23	1.17	.00	-.23	-1.17	.00
12	.08	1.19	.00	-.08	-1.19	.00
13	-.08	1.19	.00	.08	-1.19	.00
14	-.23	1.17	.00	.23	-1.17	.00
15	-.38	1.13	.00	.38	-1.13	.00
16	-.53	1.07	.00	.53	-1.07	.00
17	-.66	.99	-.70	.66	.02	.70
18	-.65	-.10	-.70	.65	1.11	.70
19	-.50	-1.19	-.70	.50	2.19	.70
20	-.21	-2.24	-.70	.21	3.25	.70
21	.21	-3.25	.70	-.21	2.24	-.70
22	.50	-2.19	.70	-.50	1.19	-.70
23	.65	-1.11	.70	-.65	.10	-.70
24	.66	-.02	.70	-.66	-.99	-.70
25	.53	1.07	.00	-.53	-1.07	.00
26	.38	1.13	.00	-.38	-1.13	.00
27	.23	1.17	.00	-.23	-1.17	.00
28	.08	1.19	.00	-.08	-1.19	.00
29	-.08	1.19	.00	.08	-1.19	.00
30	-.23	1.17	.00	.23	-1.17	.00
31	-.38	1.13	.00	.38	-1.13	.00
32	-.53	1.07	.00	.53	-1.07	.00
33	-.66	.99	-.70	.66	.02	.70
34	-.65	-.10	-.70	.65	1.11	.70
35	-.50	-1.19	-.70	.50	2.19	.70
36	-.21	-2.24	-.70	.21	3.25	.70
37	.21	-3.25	.70	-.21	2.24	-.70
38	.50	-2.19	.70	-.50	1.19	-.70
39	.65	-1.11	.70	-.65	.10	-.70
40	.66	-.02	.70	-.66	-.99	-.70
41	.53	1.07	.00	-.53	-1.07	.00
42	.38	1.13	.00	-.38	-1.13	.00
43	.23	1.17	.00	-.23	-1.17	.00
44	.08	1.19	.00	-.08	-1.19	.00
45	-.08	1.19	.00	.08	-1.19	.00
46	-.23	1.17	.00	.23	-1.17	.00
47	-.38	1.13	.00	.38	-1.13	.00
48	-.53	1.07	.00	.53	-1.07	.00

SUPPORT REACTIONS

JOINT	X REACT	Y REACT	Z REACT
5	.000	.000	1.400
21	.000	.000	1.400
37	.000	.000	1.400



Internal Forces of Typical member 8 Member Axes

3.5 Space Truss Analysis (STRUSS)

The Space Truss program analyzes space trusses of prismatic bars that take axial loads and shear forces. Presently, it can handle trusses having 150 members and 50 joints. Any joint can be given vertical and horizontal displacements.

SPACE TRUSS PROGRAM SCREEN SUMMARY

STRUCTURAL DATA SCREEN

NUMBER OF MEMBERS:
MODULUS OF ELASTICITY (KSI):
NUMBER OF JOINTS:

JOINT INFORMATION SCREEN

COORDINATE OF JOINT IN X DIRECTION (INCHES):
COORDINATE OF JOINT IN Y DIRECTION (INCHES):
COORDINATE OF JOINT IN Z DIRECTION (INCHES):
TRANSLATION RESTRAINT IN X DIRECTION:
TRANSLATION RESTRAINT IN Y DIRECTION:
TRANSLATION RESTRAINT IN Z DIRECTION:

MEMBER INFORMATION SCREEN

LEFT JOINT INDEX FOR THE MEMBER:
RIGHT JOINT INDEX FOR THE MEMBER:
AREA OF MEMBER:

LOAD CASE INFORMATION SCREEN

NUMBER OF LOADED JOINTS:
NUMBER OF LOADED MEMBERS:
NUMBER OF JOINTS WHERE A PRESCRIBED SETTLEMENT IS GIVEN:
DESCRIPTION:

SETTLEMENT INFORMATION SCREEN

JOINT NUMBER WHERE A SETTLEMENT IS GIVEN:
GIVEN TRANSLATION SETTLEMENT IN X DIRECTION (INCHES):
GIVEN TRANSLATION SETTLEMENT IN Y DIRECTION (INCHES):
GIVEN TRANSLATION SETTLEMENT IN Z DIRECTION (INCHES):

JOINT LOAD INFORMATION SCREEN

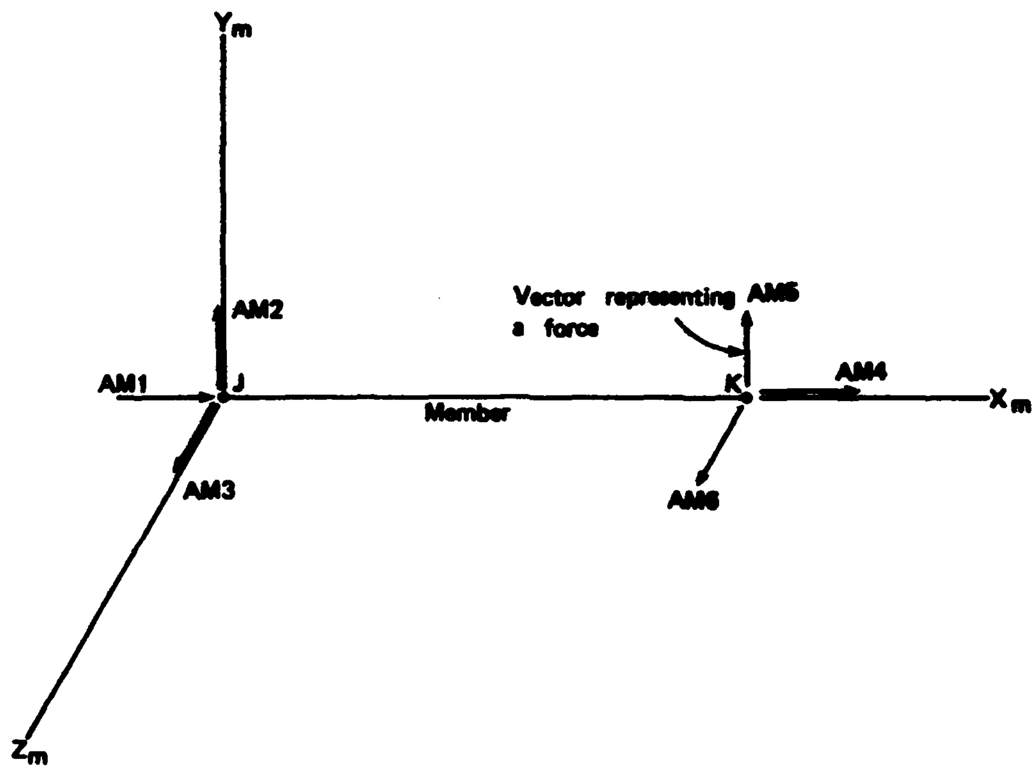
JOINT NUMBER WHERE A JOINT LOAD IS GIVEN:
FORCE IN X DIRECTION (KIPS):
FORCE IN Y DIRECTION (KIPS):
FORCE IN Z DIRECTION (KIPS):

MEMBER LOADING INFORMATION SCREEN

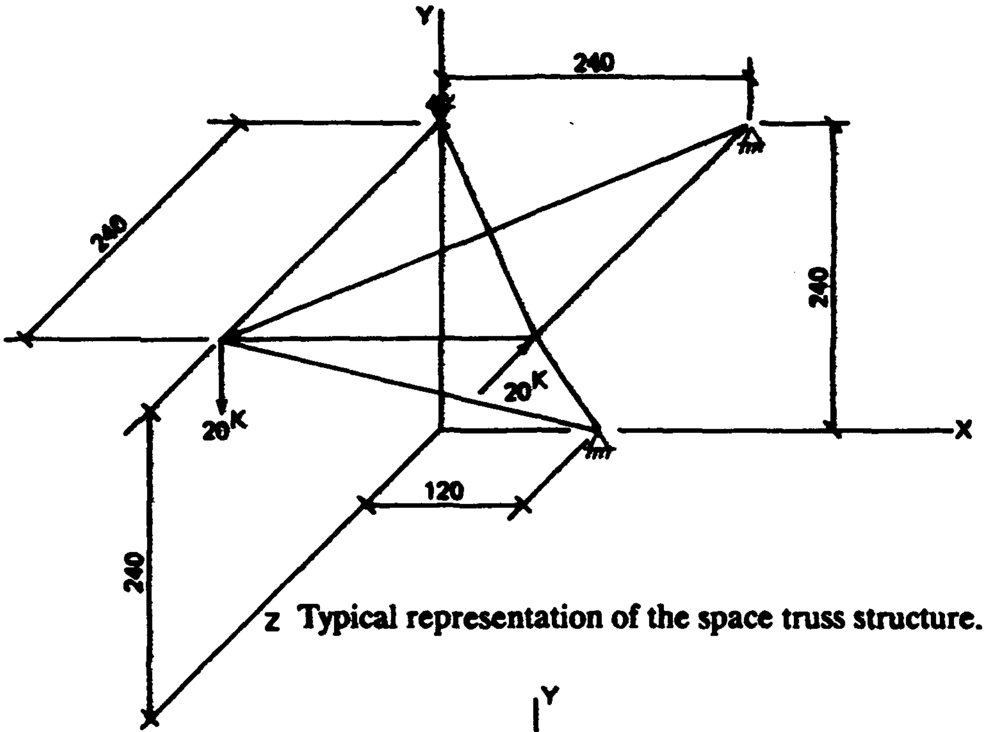
MEMBER NUMBER:
FORCE IN X_m DIRECTION AT J END (KIPS):
FORCE IN Y_m DIRECTION AT J END (KIPS):
FORCE IN Z_m DIRECTION AT J END (KIPS):
FORCE IN X_m DIRECTION AT K END (KIPS):
FORCE IN Y_m DIRECTION AT K END (KIPS):
FORCE IN Z_m DIRECTION AT K END (KIPS):

MORE LOAD CASE INFORMATION SCREEN

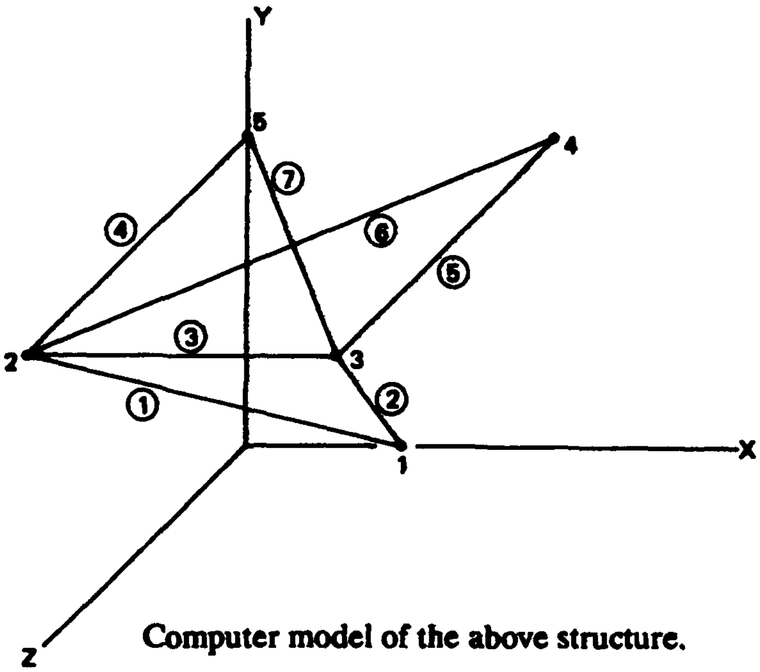
DO YOU WISH TO INPUT ADDITIONAL LOAD CASES (Y/N):



Typical axes orientation for a space truss member; positive directions shown.



Typical representation of the space truss structure.



Computer model of the above structure.

INPUT FILE

```
  7  30000.00      5
  1    120.00        .00        .00     1     1     1
  2       .00     240.00     240.00     0     0     0
  3    240.00     240.00     240.00     0     0     0
  4    240.00     240.00        .00     1     1     1
  5       .00     240.00        .00     1     1     1
  1    1    2      10.00
  2    1    3      10.00
  3    2    3      10.00
  4    2    5      10.00
  5    3    4      10.00
  6    2    4      10.00
  7    3    5      10.00
  2    0    0    CASE 1
  2       .00     -20.00        .00
  3       .00        .00     -20.00
100
```

OUTPUT FILE

ANALYSIS OF SPACE TRUSSES
****

STRUCTURAL DATA

NUMBER OF MEMBERS	7
MODULUS OF ELASTICITY IN KSI	30000.00
NUMBER OF JOINTS	5

COORDINATES OF JOINTS				JOINT RESTRAINTS		
JOINT	X	Y	Z	X RSTRT	Y RSTRT	Z RSTRT
1	120.00	0.00	0.00	1	1	1
2	0.00	240.00	240.00	0	0	0
3	240.00	240.00	240.00	0	0	0
4	240.00	240.00	0.00	1	1	1
5	0.00	240.00	0.00	1	1	1

MEMBER INFORMATION

MEMBER	JJ	JK	AX	L	CX	CY	CZ
1	1	2	10.00	360.00	-0.3333	0.6667	0.6667
2	1	3	10.00	360.00	0.3333	0.6667	0.6667
3	2	3	10.00	240.00	1.0000	0.0000	0.0000
4	2	5	10.00	240.00	0.0000	0.0000	-1.0000
5	3	4	10.00	240.00	0.0000	0.0000	-1.0000
6	2	4	10.00	339.41	0.7071	0.0000	-0.7071
7	3	5	10.00	339.41	-0.7071	0.0000	-0.7071

LOADING DATA   CASE 1

NUMBER OF LOADED MEMBERS	0
NUMBER OF LOADED JOINTS	2
NUMBER OF PRESCRIBED SETTLEMENTS	0

ACTIONS APPLIED AT JOINTS

JOINT	X ACTION	Y ACTION	Z ACTION
2	0.00	-20.00	0.00
3	0.00	0.00	-20.00

JOINT DISPLACEMENTS

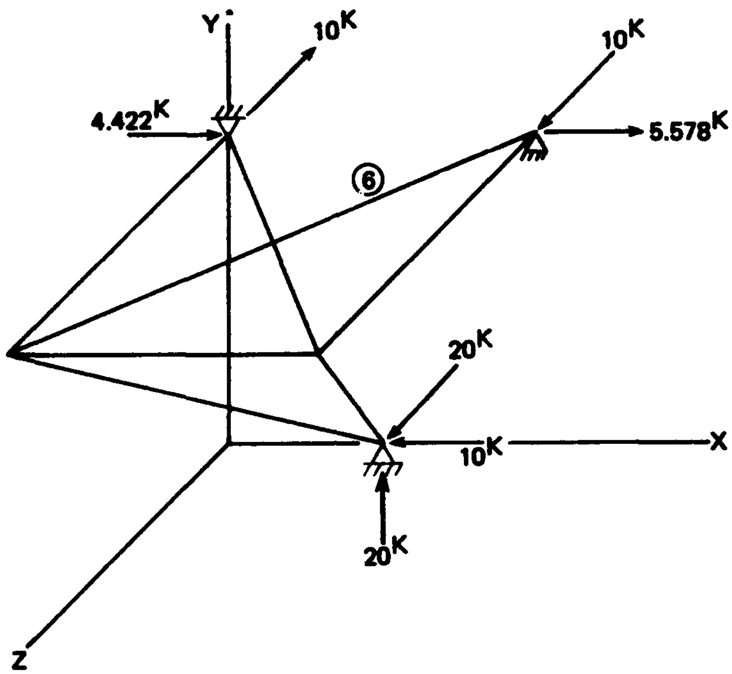
JOINT	X DISPL.	Y DISPL.	Z DISPL.
1	0.000D+00	0.000D+00	0.000D+00
2	-0.108D-02	-0.661D-01	0.115D-01
3	0.246D-02	0.112D-01	-0.125D-01
4	0.000D+00	0.000D+00	0.000D+00
5	0.000D+00	0.000D+00	0.000D+00

MEMBER END-ACTIONS

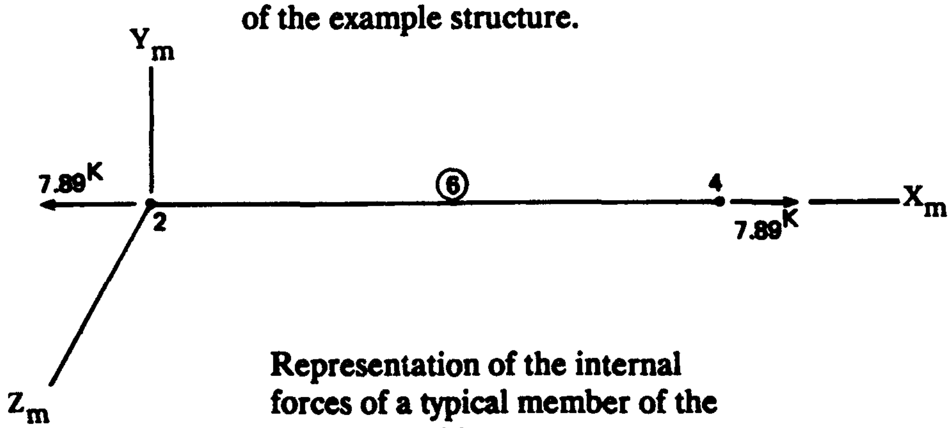
MEMBER	AM1 (AXIAL)	AM2 (SHEAR)	AM3 (SHEAR)	AM4 (AXIAL)	AM5 (SHEAR)	AM6 (SHEAR)
1	30.00	0.00	0.00	-30.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00
3	-4.42	0.00	0.00	4.42	0.00	0.00
4	-14.42	0.00	0.00	14.42	0.00	0.00
5	15.58	0.00	0.00	-15.58	0.00	0.00
6	-7.89	0.00	0.00	7.89	0.00	0.00
7	6.25	0.00	0.00	-6.25	0.00	0.00

SUPPORT REACTIONS

JOINT	X REACT	Y REACT	Z REACT
1	-10.000	20.000	20.000
4	5.578	0.000	10.000
5	4.422	0.000	-10.000



Representation of the global reactions of the example structure.



Representation of the internal forces of a typical member of the example problem.

3.6 Space Frame Analysis (SFRAME)

The Space Frame program analyzes space frames of prismatic bars that take axial loads, shear forces, torsion, and moments. Presently, it can handle frames having 50 members and 25 joints. Any joint can be given vertical, horizontal, and angular displacements.

The data input may be modified to consider a composite frame. If members are going to take axial loads only, such as tie rods, make the moments of inertia and torsion constants very small and use the actual areas. If axial deformation is to be neglected, make the member areas large and use the actual moments of inertia and torsion constants.

Hinges can be accounted for by placing a short, flimsy member at the desired hinge location. A member length of 0.01 inch with moments of inertia and a torsion constant of 0.0001 has been used successfully.

A space frame member may have its principal axes Y_m and Z_m in skew directions within the structure. It becomes necessary to specify the orientation of those principal axes; that is most easily accomplished by locating a point that lies in one of the principal planes of the member, but is not on the member axis itself. The Typical Member Axes Orientation, as shown in a following sketch, refers to the existence of a point "p" that lies in a X_m - Y_m plane of a member. The point "p" is located by global coordinates, X_p, Y_p and Z_p. On the Member Information Screen, each member requires input about the Angle Alpha indicator. It is either "0" or the integer "1". When the member's principal axes are not skewed, use "0". If on the other hand, the member is skewed, use "1" and a Member (Alpha) Information Screen will follow immediately asking for the global coordinates of a point "p". Members that have a cross-section that are either circular or square (solid or tubular) are not considered skewed because any set of axes could be the principal axes.

SPACE FRAME PROGRAM SCREEN SUMMARY

STRUCTURAL DATA SCREEN

NUMBER OF MEMBERS:
MODULUS OF ELASTICITY:
MODULUS OF RIGIDITY:
NUMBER OF JOINTS:

JOINT INFORMATION SCREEN

COORDINATE OF JOINT IN X DIRECTION (INCHES):
COORDINATE OF JOINT IN Y DIRECTION (INCHES):
COORDINATE OF JOINT IN Z DIRECTION (INCHES):
TRANSLATION RESTRAINT IN X DIRECTION:
TRANSLATION RESTRAINT IN Y DIRECTION:
TRANSLATION RESTRAINT IN Z DIRECTION:
ROTATIONAL RESTRAINT ABOUT X AXIS:
ROTATIONAL RESTRAINT ABOUT Y AXIS:
ROTATIONAL RESTRAINT ABOUT Z AXIS:

MEMBER INFORMATION SCREEN

LEFT JOINT INDEX FOR THE MEMBER:
RIGHT JOINT INDEX FOR THE MEMBER:
AREA OF MEMBER (SQ-IN):
TORSION CONSTANT FOR MEMBER (INCHES**4):
MOMENT OF INERTIA ABOUT Y_m AXIS (INCHES**4):
MOMENT OF INERTIA ABOUT Z_m AXIS (INCHES**4):
ANGLE ALPHA INDICATOR:

MEMBER (ALPHA) INFORMATION SCREEN

X COORDINATE OF A POINT:
Y COORDINATE OF A POINT:
Z COORDINATE OF A POINT:

LOAD CASE INFORMATION SCREEN

NUMBER OF LOADED JOINTS:
NUMBER OF LOADED MEMBERS:
NUMBER OF JOINTS WHERE A PRESCRIBED SETTLEMENT IS GIVEN:
DESCRIPTION:

SETTLEMENT INFORMATION SCREEN

JOINT NUMBER WHERE A SETTLEMENT IS GIVEN:
GIVEN TRANSLATION SETTLEMENT IN X DIRECTION (INCHES):
GIVEN TRANSLATION SETTLEMENT IN Y DIRECTION (INCHES):
GIVEN TRANSLATION SETTLEMENT IN Z DIRECTION (INCHES):
GIVEN ROTATIONAL SETTLEMENT ABOUT X AXIS (RADIANS):
GIVEN ROTATIONAL SETTLEMENT ABOUT Y AXIS (RADIANS):
GIVEN ROTATIONAL SETTLEMENT ABOUT Z AXIS (RADIANS):

JOINT LOAD INFORMATION SCREEN

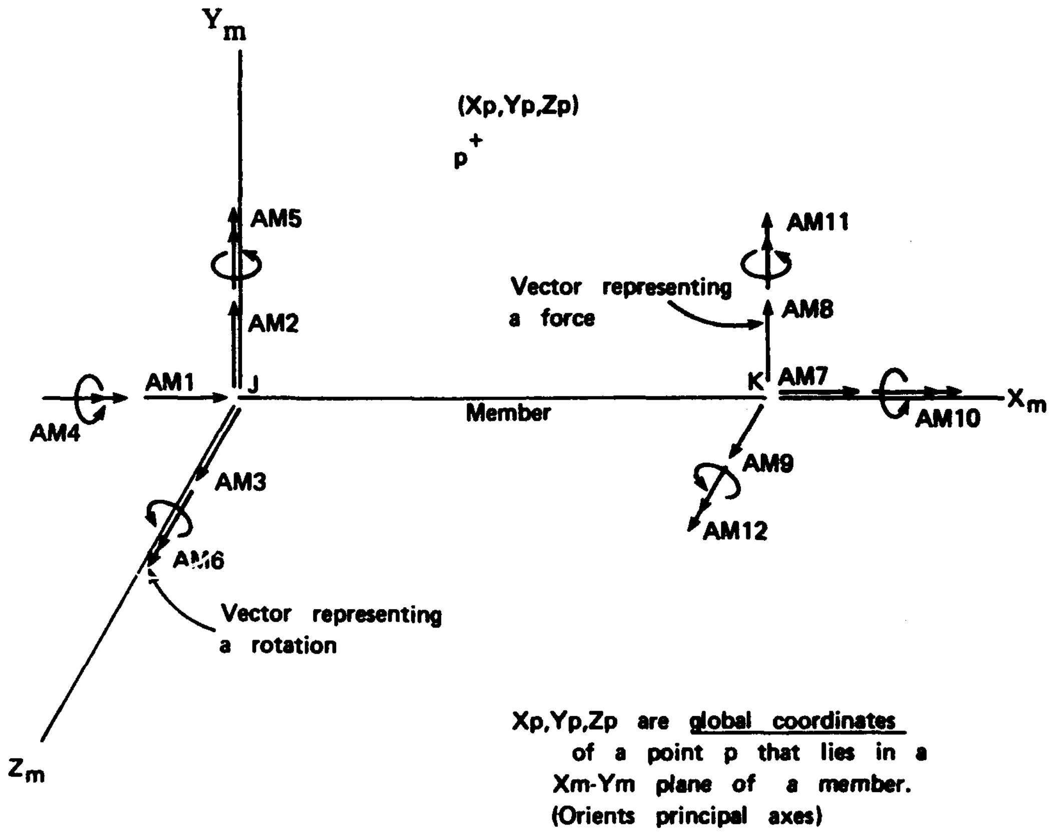
JOINT NUMBER WHERE A JOINT LOAD IS GIVEN:
FORCE IN X DIRECTION (KIPS):
FORCE IN Y DIRECTION (KIPS):
FORCE IN Z DIRECTION (KIPS):
MOMENT ABOUT X AXIS (INCH-KIPS):
MOMENT ABOUT Y AXIS (INCH-KIPS):
MOMENT ABOUT Z AXIS (INCH-KIPS):

MEMBER LOADING INFORMATION SCREEN

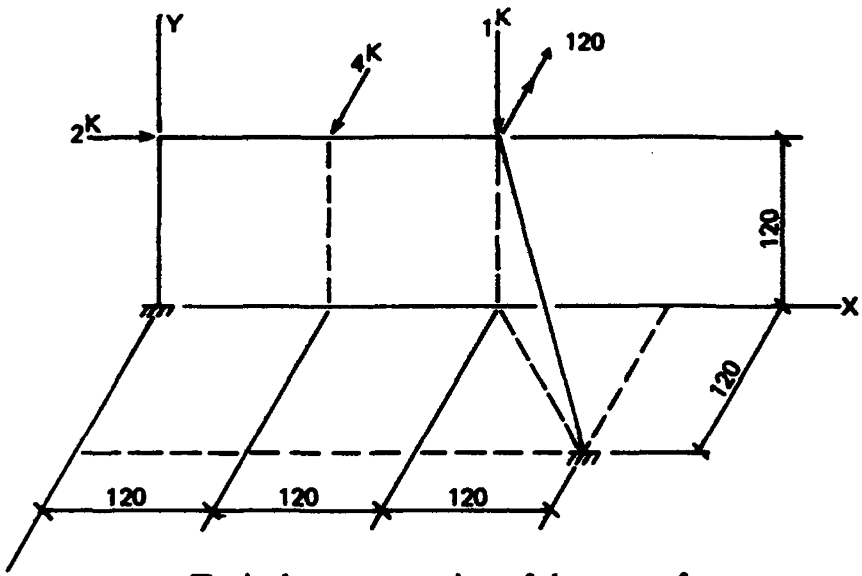
FORCE IN X_m DIRECTION AT J END (KIPS):
FORCE IN Y_m DIRECTION AT J END (KIPS):
FORCE IN Z_m DIRECTION AT J END (KIPS):
MOMENT ABOUT X_m AXIS AT J END (INCH-KIPS):
MOMENT ABOUT Y_m AXIS AT J END (INCH-KIPS):
MOMENT ABOUT Z_m AXIS AT J END (INCH-KIPS):
FORCE IN X_m DIRECTION AT K END (KIPS):
FORCE IN Y_m DIRECTION AT K END (KIPS):
FORCE IN Z_m DIRECTION AT K END (KIPS):
MOMENT ABOUT X_m AXIS AT K END (INCH-KIPS):
MOMENT ABOUT Y_m AXIS AT K END (INCH-KIPS):
MOMENT ABOUT Z_m AXIS AT K END (INCH-KIPS):

MORE LOAD CASE INFORMATION SCREEN

DO YOU WISH TO INPUT ADDITIONAL LOAD CASES (Y/N)?

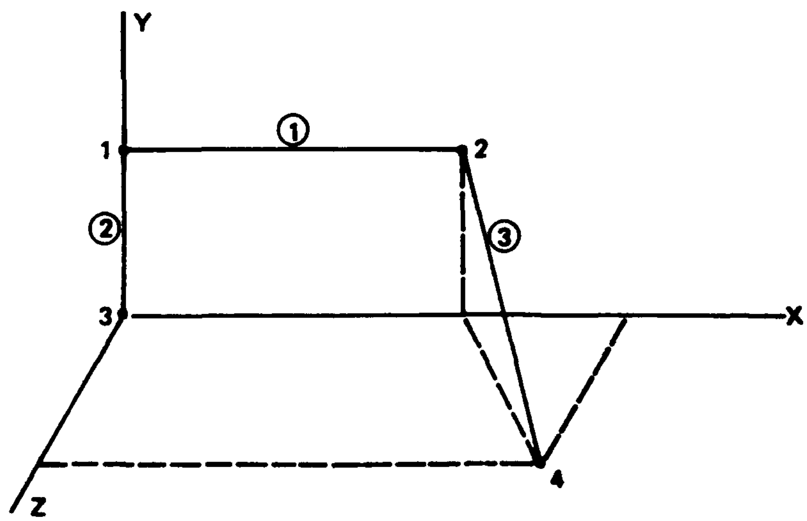


Typical axes orientation for a space frame member; positive direction shown.



E=30000 ksi
G=12000 ksi
$AX=11in^2$
$IX=83in^4$
$IY=IZ=56in^4$

Typical representation of the space frame structure.



Computer model of the above structure.

INPUT FILE

```
3   30000.00   12000.00     4
1        .00     120.00        .00
2     240.00     120.00        .00
3        .00        .00        .00   1   1   1   1   1   1
4     360.00        .00     120.00   1   1   1   1   1   1
1    1    2      11.00       83.0      56.0      56.0   0
2    3    1      11.00       83.0      56.0      56.0   0
3    2    4      11.00       83.0      56.0      56.0   0
2    1    0    EXAMPLE
1       2.00        .00        .00       .00       .00       .00
2        .00      -1.00        .00       .00       .00   -120.00
1        .00        .00      -2.00       .00    120.00       .00
         .00        .00      -2.00       .00   -120.00       .00
100
```

OUTPUT FILE

ANALYSIS OF SPACE FRAMES
****

STRUCTURAL DATA

NUMBER OF MEMBERS	3
MODULUS OF ELASTICITY IN KSI	30000.00
MODULUS OF RIGIDITY IN KSI	12000.00
NUMBER OF JOINTS	4

COORDINATES OF JOINTS

JOINT	X	Y	Z
1	0.00	120.00	0.00
2	240.00	120.00	0.00
3	0.00	0.00	0.00
4	360.00	0.00	120.00

JOINT RESTRAINTS

JOINT	X TRANS	Y TRANS	Z TRANS	X ROTA	Y ROTA	Z ROTA
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	1	1	1	1	1	1
4	1	1	1	1	1	1

MEMBER INFORMATION

MEMBER	JJ	JK	AX	RIX	RIY	RIZ	IAA	L	CX	CY	CZ
1	1	2	11.00	83.0	56.0	56.0	0	240.0	1.000	0.000	0.000
2	3	1	11.00	83.0	56.0	56.0	0	120.0	0.000	1.000	0.000
3	2	4	11.00	83.0	56.0	56.0	0	207.8	0.577	-0.577	0.577

LOADING DATA EXAMPLE

NUMBER OF LOADED MEMBERS	1
NUMBER OF LOADED JOINTS	2
NUMBER OF PRESCRIBED SETTLEMENTS	0

ACTIONS APPLIED AT JOINTS

JOINT	X FORCE	Y FORCE	Z FORCE	X MOMENT	Y MOMENT	Z MOMENT
1	2.00	0.00	0.00	0.00	0.00	0.00
2	0.00	-1.00	0.00	0.00	0.00	-120.00

ACTIONS AT ENDS OF RESTRAINED MEMBERS DUE TO LOADS

MEMBER	AML1 AML7 (AXIAL)	AML2 AML8 (SHEAR)	AML3 AML9 (SHEAR)	AML4 AML10 (TOR)	AML5 AML11 (MOM)	AML6 AML12 (MOM)
1	0.00	0.00	-2.00	0.00	120.00	0.00
	0.00	0.00	-2.00	0.00	-120.00	0.00

JOINT DISPLACEMENTS

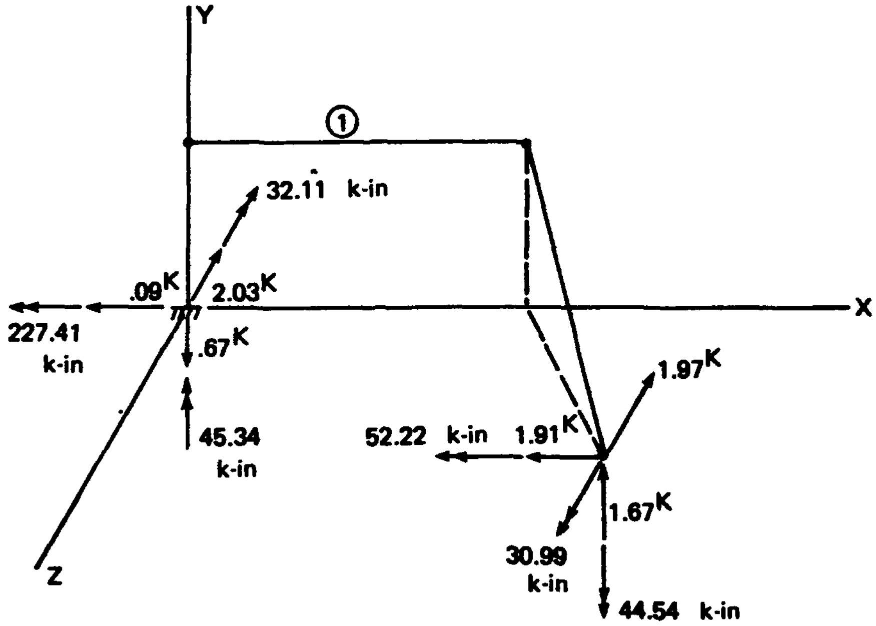
JOINT	X TRAN	Y TRAN	Z TRAN	X ROTA	Y ROTA	Z ROTA
1	-0.153D+00	0.244D-03	0.626D+00	0.754D-02	-0.546D-02	0.267D-02
2	-0.154D+00	0.456D+00	0.614D+00	0.358D-02	0.575D-02	-0.270D-02
3	0.000D+00	0.000D+00	0.000D+00	0.000D+00	0.000D+00	0.000D+00
4	0.000D+00	0.000D+00	0.000D+00	0.000D+00	0.000D+00	0.000D+00

MEMBER END-ACTIONS

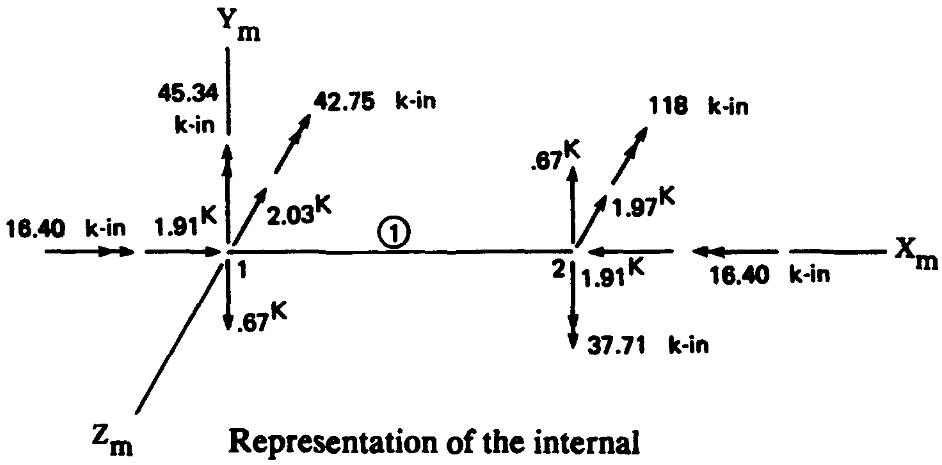
MEMBER	AM1 AM7 (AXIAL)	AM2 AM8 (SHEAR)	AM3 AM9 (SHEAR)	AM4 AM10 (TOR)	AM5 AM11 (MOM)	AM6 AM12 (MOM)
1	1.91	-0.67	-2.03	16.40	45.34	-42.75
	-1.91	0.67	-1.97	-16.40	-37.71	-118.00
2	-0.67	0.09	-2.03	45.34	227.41	-32.11
	0.67	-0.09	2.03	-45.34	16.40	42.75
3	3.20	0.22	0.04	-13.46	36.67	-13.01
	-3.20	-0.22	-0.04	13.46	-45.03	58.84

SUPPORT REACTIONS

JOINT	X FORCE	Y FORCE	Z FORCE	X MOMENT	Y MOMENT	Z MOMENT
1	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00
3	-0.09	-0.67	-2.03	-227.41	45.34	-32.11
4	-1.91	1.67	-1.97	-52.22	-44.54	30.99



Representation of the global reactions of the example structure.



Representation of the internal forces of a typical member of the example problem.

STRUCTURAL ANALYSIS CODE KIT

FEEDBACK REPORT

The Naval Civil Engineering Laboratory is fully dedicated to supporting GEMS users. A primary requirement for this task is to establish a priority listing of user requirements. It would be of great value to the development of new software if you, the user, would complete the feedback questions below. Since each individual user may have specific requirements, please reproduce this page as many times as necessary.

Please circle the number that best applies in questions 1 through 4, complete the other questions, fold at tic marks, and mail to NCEL with franked label on reverse side or to address at bottom of page.

1. Was the software beneficial (productive)?

   No benefit 0 1 2 3 4 5 6 7 8 9 10 Very beneficial

2. Was it easy to use (user friendly)?

   Difficult 0 1 2 3 4 5 6 7 8 9 10 Very easy

3. Does this software make decisions more reliable?

   No 0 1 2 3 4 5 6 7 8 9 10 Yes

4. Does it better document the design?

   No 0 1 2 3 4 5 6 7 8 9 10 Yes

5. Did it save time?

   Yes_____ No_____ Estimated percent saved_____

6. What would make future software more user friendly?

7. What further support would you like to have on the GEMS system?

8. What other comments or remarks would you like to add?

Activity____
Telephone____

Mail address is:

NAVFAC GEMS Support Group
Naval Civil Engineering Laboratory
Code L54
Port Hueneme, CA 93043-5003

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